THE
MANOEUVERER,
OR
SKILFUL SEAMAN:
BEING
An ESSAY on the THEORY and PRACTICE
OF THE
VARIOUS MOVEMENTS OF A SHIP AT SEA,
AS WELL AS OF
NAVAL EVOLUTIONS IN GENERAL.

Tranſlated from the French of Mr. BOURDÉ de VILLEHUET,

BY THE CHEVALIER DE SAUSEUIL.

Illuſtrated with THIRTEEN COPPERPLATES;

FIVE of which, with many intereſting Obſervations interſperſed through the Work, by way of Notes, are the Production of an ENGLISH OFFICER.

DEDICATED, BY PERMISSION,

TO HIS ROYAL HIGHNESS THE DUKE OF CLARENCE.

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TO

HIS ROYAL HIGHNESS
The DUKE *of* CLARENCE.

May it please your ROYAL HIGHNESS!

THE early attention which your ROYAL HIGHNESS hath ſo eminently diſplayed to the welfare of England, in your attachment to Nautical Studies, and the unremitted ardour with which you ſo ſucceſsfully perſevere in the ſame glorious purſuits, muſt afford every true lover of this Country the happieſt preſages of what your future exertions may accompliſh in ſupport of your own fame, and the reputation of the whole Britiſh Empire.

THE People of Great-Britain feel a due ſenſe of their obligations to your ROYAL HIGHNESS, for having ſo nobly relinquiſhed all the allurements of eaſe and pleaſure, to court dangers and difficulties, on the

roughest

roughest element, in defence of the Nation: agreeing with the general voice of esteem and applause, and considering it the duty as well as the interest of every individual to second, by all possible means, your laudable efforts, the Translator humbly ventures to offer the following System of Naval Tactics to your perusal. The high degree of reputation in which the Original is held by men of nautical skill in France, is the best apology for presuming to introduce it here under your ROYAL HIGHNESS's patronage.

THAT your ROYAL HIGHNESS may be no less distinguished for superior acquirements in Naval Science, than for pre-eminence of Rank, is the ardent wish of

Your ROYAL HIGHNESS's

Most devoted, and

Most respectful humble Servant,

LE CHEV. DE SAUSEUIL.

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TRANSLATOR's PREFACE.

FROM the extraordinary reputation which M. BOURDÉ has generally acquired among all Sea Officers of professional abilities in France, and the very distinguished manner in which the Academy of Sciences in Paris have expressed their approbation of his SYSTEM of NAVAL TACTICS, it cannot be supposed but that a Translation of that Work must prove acceptable, and even useful, here, as every care has been taken to convey in English the judicious principles and reasoning of the ingenious French Author.—The only difficulty in this undertaking was to guard against the possibility of misconception which might arise from the multiplicity of technical terms and sea phrases, which necessarily occur in a Work of this kind. To obviate this, I have, as I proceeded in the Translation, regularly consulted a British Naval Officer of experience and capacity, on every doubt I had as to the meaning of the original. From that Gentleman I derived much assistance; and I would here most cheerfully express my acknowledgements to him by name, were I not fearful of offending his delicacy by such a public testimony of his liberal information. Hence I flatter myself that I may now venture to assure the Public, that M. BOURDÉ is rendered into English with that degree of accuracy which will make his precepts perfectly clear to every reader, and that he will be found as conducive to the instruction and improvement of those who are desirous of applying to Nautical Studies, as he is universally esteemed by those of his own countrymen who are devoted to similar pursuits.

ANOTHER

ANOTHER able British Officer having translated the greatest part of our Author, for his private use, and added many very ingenious and useful Observations, with FIVE Drawings of his own, to illustrate them, they appeared to us of too great importance to be omitted: therefore, we have enriched the Work with both his Drawings* and his Observations, the latter of which will be found printed by way of notes at the bottom of the pages wherever they occurred†.

FROM these circumstances, and the peculiar utility of such Works to a maritime nation like England, we are led to presume we shall not be found to have employed our time in a manner unprofitable or dissatisfactory to the Public.

MORE intent sometimes on rendering the true meaning of our Author than on the elegance of the diction, we will not presume to affirm that we shall not be found to have now and then inadvertently made use of some Gallicisms, instead of the exact English idiom; but we hope none of them are such as to obscure the sense, and that the indulgent Reader will readily pardon them.

March 1, 1788.

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* Plates I, VII, VIII, IX, & X, of Evolutions, are additional, and engraved from the five above-mentioned Drawings.

† These Observations are printed by way of notes in the following pages, *viz.* 41, 59, 60, 77, 80, 81, 96, 97, 98, 99, 100, 101, 102, 107, 124, 131, 230, 244, 245, 250, 256, 257, & 264.

THE

E R R A T A.

Page	Line	
4	7	*for* ones, *read* one
6	5	*for* surfaces only, when, *read* surfaces, only when
ibid.	13	*for* diminished: therefore, *read* smaller: so that
ibid.	16	*for* these being considered, *read* as being considered only
34	24	*dele* little
	25	*for* top gallant, *read* top-gallant sail
	26	*for* fore-top yard, *read* fore-top sail yard
35,	*penult.*	*for* in the main fore-top shrouds, *read* in the fore-top-mast shrouds
66	9	*dele* quite home
69	9	*for* tally, *read* and sheet home
	21	*for* highest, *read* greatest
71	9	*for* swings, *read* rides
	17	*for* enough, *read* cast sufficiently
	20	*dele* off
7[illegible]	26	*for* fore-top stay-sail, *read* fore-top-mast stay sail
73	4	*dele* up
77	20	*for* windward, *read* leeward
78	13	*for* filled, *read* hauled or braced about
	30	*for* fill, *read* trim
79	3	*for* filled, *read* hauled
80	5	*for* off all, *read* of all
87	5	*for* makes, *read* builds
	Note	*for* to be chapelling, *read* to build a chapel
91	11	*for* fore-sails, *read* head-sails
93	8	*for* the top-sail, *read* the fore top-sail
97	16	*for* a-dry, *read* a-try
103	1	*for* right aft the yard, *dele* the yard
116	22	*for* heaved short, *read* shot
129	19	*for* on board, *read* hard
130	1	*for* fatigued, *read* strained
	28	*for* furled, *read* brailed
131	14	*for* ride, *read* come
132	29	*for* cast, *read* fix
135	31	*for* fatiguing, *read* straining
149	25	*between* side *and* of, *add* surface
170	4	*for* softness or hardness, *read* easiness or violence
171	17	*for* hardest, *read* most violent
174	1	*for* or tally, *read* the tacks or sheet of
185	2	*for* a-head than a-stern, *read* foreward than abaft
	29	*for* to put or tack, *read* to tack or put
201	5	*for* shelter at least, *read* shelter (at least
	ibid.	*for* some, *read* from
	6	*for* bullets, *read* bullets)
212,	*Note, l. ult.*	*for* trusted, *read* thrusted
224	26	*for* Rear-Admiral, *read* Vice-Admiral
	27	*for* broad pendant, *read* flag
232,	*Note*, l. 8,	for *five*, read *four*.
277,	15&23	*for* file, *read* fill
282	21	*for* by, *read* in.

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THE

FRENCH AUTHOR's

PREFACE.

NAVIGATION hath made greater progreſs in Europe within this century than in all preceding times ſince the diſcovery of the Mariner's Compaſs; and this has been owing to the lights derived from Aſtronomy, Geometry, Geography, and other ſciences which contribute to its improvement. We ſhould not however fondly imagine that all parts of this great Art have been fully inveſtigated and explained, and that there is no room left for farther reſearch or enquiry. The ſureſt obſtacle to the improvement of Arts and Sciences would be to reſt ſatisfied with the knowledge we have already acquired, and forbear all attempts to increaſe it. It is characteriſtical of the activity of the human mind to be continually buſy within its proper ſphere, otherwiſe this activity decays and is ſoon extinguiſhed; as in a machine, of which motion alone is the ſoul, the power and uſe of its ſprings or wheels are frequently deſtroyed by inaction.

All our knowledge is compoſed of theory and practice, and the one cannot ſubſiſt without the other: they muſt therefore go hand in hand together; and, in the art of Navigation particularly, they ſhould be inſeparable.

a Several

THE FRENCH AUTHOR's

SEVERAL parts of general Hydrography, both theoretical and practical, have been succesfully explained—The Works of Pere *Fournier*, Pere *Hoste*, Monf. *Bouguer*, and Monf. *Morogues*, have all their peculiar merits. But, Ship-Manœuvres had not yet been sufficiently elucidated, nor regularly explained, by men of the profession. I have therefore thought necessary to consider this important object with particular attention.

THE Work of P. Hoste, in which this object is comprised, was written above seventy years ago; it is now scarce, and both Manœuvres and Tactics have been considerably improved since that period. That of M. Bouguer, published in 1757, includes likewise a general Theory of Manœuvres; but, to be able to understand this Author properly, a considerable degree of geometrical knowledge and experience is necessary: besides, how multifarious are the operations which are to be acquired only at sea! I must indeed confess I have derived considerable assistance from some of those Works, and the excellent Theory which they contain has been the basis of my System: but I have added my own reflections and ideas, and many combinations, which I have had opportunities of making in actual service, with respect to ship-manœuvres at sea and in harbour.

I SHALL not attempt to explain here the whole extent of my Work. The accurate and learned analysis given of it by the Commissaries of the Royal Academy in their Report, and which is annexed to this Preface, makes it unnecessary to enter into such a detail, especially as I could not hope to present it with equal precision. I shall only mention therefore to the Reader my reasons for dividing the Work into Four Parts.

THE

The First, consisting of Theory, on which the whole Work is founded, is so far elementary that it may be readily comprehended by a proper attention on the part of the Reader.

The Second Part is merely practical. I consider the Ship in motion at sea, under sail, and in every possible situation. This part of manœuvres, which is the most brilliant, requires chiefly great spirit and activity in the execution.

The Third Part contains various Observations; and, according to circumstances, is blended with Practice and Theory. I consider the Sea Officer, on this occasion, as an observer attentive to every object which can possibly contribute to his advancement in theoretical and practical knowledge.

The Fourth and last Part treats of Naval Evolutions and Signals. This is properly the science of the Admiral or Commander at sea, as well as of every Officer who serves in a fleet, a squadron, or any other division. Many things may be found in this Part which are not to be met with in other Works.

To the detail of Manœuvres comprised in this Work, if the Reader will but add those parts which I have not touched upon, only because they have been treated of by others, and were not properly connected with my plan, he will thence easily conceive the multiplicity and variety of knowledge necessary to form the complete Mariner.

When we consider our Marine, the extent of our Navigation, and the vast number of ships which must be necessarily maintained, even in times of peace, for the support and protection of commerce, we plainly perceive that the number of Officers, of all

 ranks,

ranks, employed in the Navy, muſt be very conſiderable. But were we to examine the capacity of each in particular, we ſhould find very few regularly inſtructed in Ship-Manœuvres, which muſt however be the continual occupation of the Mariner in the courſe of his voyages, as he will neceſſarily be conſtantly in action either to accelerate or retard the motion of his ſhip.

THOSE who have no other guide but mechanical Routine or Practice, or have learned nothing but from common ſervice, generally find themſelves greatly embarraſſed upon any ſudden and extraordinary event which happens at ſea, particularly in an engagement, where the fire of the enemy, or their own, by dividing the Officer's attention, is apt to diſturb the execution of the manœuvres.

IT is in the critical circumſtances of an obſtinate and uncertain conflict that Theory admirably ſeconds the efforts of Practice, eſpecially when we enjoy the advantage of having ſo happily united them by conſtant ſtudy and reflection, that we ſcarcely perceive there are any other combinations neceſſary, to give the proper motion to the ſhip, but thoſe in common Practice.

THIS Practice, more active in appearance, ſeems to have the advantage over Theory with regard to promptitude and diſpatch; but the latter, more uniform and certain, is more likely to ſecure ſucceſs in whatever is undertaken, than mere Practice unaſſiſted by regular principles. To form the complete Adept in Manœuvres, Study and Practice muſt therefore be united.

THE great argument of Mariners who think it unneceſſary to learn the Theory of their Profeſſion, is, that there have been ſome of the ableſt Sea-Officers formed by Practice alone. But who will preſume to aſſert that thoſe men of diſtinguiſhed Genius, whoſe names

names are famous in every harbour, *Tourville*, *Duquêne*, *D'Estrées*, *Châteaurenaud*, *Guay-Trouin*, *Barth*, *Ruiter*, *Tromp* *, &c, &c, had no theoretical knowledge? For my own part, I have too great a veneration for the memory of those heroes, to suspect them of ignorance in this essential branch of an Art so complicated as that of Navigation. Every Maritime State has produced able Mariners; but who are they that we shall venture to compare with those pre-eminent Seamen, should we even suppose them to have acted without any fixed Principles or Theory in all they have so happily accomplished? Who moreover will now venture to say that he possesses as much sagacity, penetration, and genius, to perform on occasion, with equal success and glory, what they learned from continual Practice? In a word, who shall ever find so many opportunities of improvement as they possessed, by a variety of engagements, and a multiplicity of events, during the course of a long offensive and defensive Navigation, in which they generally proved successful? We rarely see a concurrence of such events with all the qualities which were united in those great men, whose example would fain be adduced to justify the want of application and study; whole ages are necessary to produce Mariners of this uncommon stamp.

Now, since, with regard to the ordinary race of seamen, Practice alone is insufficient to raise them above mediocrity, Theory must therefore be united. Without this indispensable union, we shall never be able to approach the merits of these great models, who chiefly distinguished themselves by those bold manœuvres which generally decide the fate of engagements.

INDEED,

* To whom might be added *Blake*, *Boscawen*, *Warren*, and some others.

INDEED, experience at leaſt teaches us, that, with equal talents and equal practice, the Mariner who poſſeſſes the knowledge of Theory muſt always be ſuperior to him who is unacquainted with the latter. The man of ſound Theory, with a ſingle glance, will on occaſion direct his ſails and helm much more advantageouſly than the mere practical ſailor, becauſe the former knows how to calculate the degrees of their effects by their motion and obliquity; whereas the mere practical man will make his arrangements at random, or at beſt be guided by mechanical cuſtom; for, every mariner has his own particular method, from which he rarely deviates. Beſides, if the latter hath the good fortune to make his ſhip perform the ſame evolution with the other, it will never be done with the ſame preciſion, nor with equal diſpatch.

LET us figure to ourſelves a Mariner, not only of conſummate experience, but likewiſe furniſhed with all the advantages of regular Theory; can there be a more glorious ſight than to ſee ſuch a man in the midſt of thoſe violent ſhocks, thoſe dreadful convulſions, of contending winds and waves? Without any other reſource but what he finds in himſelf, ſuſpended between life and death, we ſee him alone, holding the fate of his ſhip in ſuſpenſe, ſtruggling to the laſt moment againſt ſurrounding deſtruction, ſkilfully combining all the fury of the element which is ready to ſwallow him, and, with calmneſs and tranquillity, ſubjecting thoſe horrors to the calculations of genius.

WHAT muſt become of the mere practical ſeaman in ſuch a critical ſituation, where his mechanical knowledge can be of no uſe? You may ſee him diſconcerted, pale, ſilent, incapable of any certain reſolution, continually repeating ſome cuſtomary manœuvres, as ill executed, in the general confuſion of the ſhip, as they are directed without principle or deſign.

I WILL

I WILL venture to make another comparison, which will set this matter in a still stronger light. All men in general, for whatever profession they may be designed, usually devote a certain number of years to the acquisition of professional knowledge. Those who are called to the first Offices, as well as the lowest mechanics, are subject to Rules and Principles, in which they endeavour to gain a proficiency. Shall the Mariner alone claim an exemption from all study and mental application? Shall he fancy that it will be sufficient for him to see what others perform in the course of a few voyages and engagements, and suppose that his eyes will instruct him better than all he can learn from study and reflection in his closet?

"A MAN must have egregious presumption and ignorance," according to the Author of the Elogium of *Du Guai Troin*, "to "flatter himself with any hopes of success in such a Profession "without having carefully studied it." And, indeed, we have many woeful examples of the irreparable errors and misfortunes which have been occasioned by presumption in this Profession.

HONOUR, that great and glorious expression, so pompously pronounced, but so ill understood, true Honour, I say, is not an idle sentiment which supinely slumbers in the human breast. It consists, with respect to a Sea-Officer, in distinguishing himself as much by Science and superior Talents as by Resolution and Courage.

IT is, therefore, for uninformed Mariners, that, prompted by an impulse of zeal for the improvement of the Navy, I have composed this Work, the fruit of reflection and study, during the course of a long series of Voyages; but I am far from pretending to offer any information to Mariners who have united Study and Practice in

the

the completion of their Professional Character—Happy in being of some use to those who may have occasion to benefit by my labour, I submit it to the judgement of the rest. Should any errors have escaped me, as I am far from having the vanity of thinking myself infallible, it will not give me the least pain to acknowledge and correct them.

Extract

Extract from the Register of the Royal Academy of Sciences, at Paris, *being a Testimony of the Merits of this Work.*

May 16, 1764.

WE have examined, by order of the Academy, a Work intituled, *Le Manœuvrier*, or the Skilful Seaman; being "An "Essay on the Theory and Practice of the various Movements of "a Ship at Sea, as well as of Naval Evolutions; by Mr. Bourdé, "Officer in the Service of the French East-India Company."

We have had but few publications hitherto on the Art of working a Ship at Sea, that are properly calculated for the Instruction of young Officers. The Book of Father Hoste, published above 70 years ago, and that of Mr. Bouguer, in 1757, are almost the only works of the kind deserving any notice. The former is nearly obsolete: the latter is an excellent Performance, wherein the most skilful Officers may find objects very essential to their professional improvement. Mr. Bourdé, sensible of this truth, wisely availed himself of them: but a considerable degree of knowledge of the subject is previously necessary, in order to draw from such a source. The study of Geometry, and experience, are requisite to understand that writer with advantage: besides, there are a multitude of operations, to be acquired only from practice, that an Officer cannot attain but

by a long acquaintance with the Sea, and which do not form a part of Mr. BOUGUER's plan. That Author treats of the Geometrical part only of the *Manœuvre:* to treat of the utility, proper application, and practice of it, was the province of a Practical Sea-Officer; and this is precisely what Mr. BOURDÉ has done in the Work before us.

AFTER having laid down, in a simple and elementary manner, the first notions on the shock of fluids, and on the movement of bodies after percussion, Mr. BOURDÉ examines in what manner the sails are acted upon by the wind, and what is the direction, as well as the true and apparent velocities of the ship in respect to the wind. He clearly demonstrates, that the several velocities of a ship are as the sines of incidence of the wind on the sail, as long as the sail continues under the same trimming or disposition in regard to the keel; and that, in order to remove the quicker from a coast, or from any given line, it is necessary the tangent of the apparent incidence be double the tangent which makes the Course with the Sail; while, at the same time, the Angle formed by the Course and the coast from which a removal is required, shall be equal to the real Angle of incidence. The Author brings, on that occasion, the Table Mr. BOUGUER has drawn up for running with the greatest velocity; but not without observing, however, at the same time, that, out of 28 Articles contained in it, there are no more than eight (about a third part only) which may be of real utility; because, in all the other cases, the Sails would *cover* each other too much. So true it is, that the most sublime Theories stand in need of being submitted to positive experience and practice, before their real advantage and proper application can be determined.

MR. BOURDÉ next considers the action of the Masts and Sails which are on the fore part of a Ship; such as the Sprit-sail, Jib, and Stay-sail, which are set on the Bowsprit, and are advantageous for

for going by the wind and making the ſhip ſteer well, eſpecially when ſhe *gripes* and requires a great deal of weather-helm: experience ſhows that they are more uſeful than the beſt theory can demonſtrate. All the other Sails are equally conſidered, with reſpect to their ſeveral uſes and functions.

The Rudder becomes afterwards the object of the Author's conſideration. He ſhows, by reaſonings as plain as they are natural and obvious, that, in practice, it is the angle of 45 degrees, or thereabouts, which is the moſt advantageous to tack the ſhip; not that of 55 degrees, ſo long inſiſted upon in all books of Geometry. But, in the ordinary conſtruction, the Tiller can hardly admit of being traverſed by 30 degrees. As for the reſt, Mr. Bourdé ſhows evidently, in regard to the Rudder, that it is to be made uſe of as little as poſſible.

The Second Part of this Work contains the application of Theory to Practice, and exhibits a demonſtration of the Evolutions of a Ship. This is the brilliant part of a Seaman's knowledge. An intelligent Officer ought to render himſelf maſter both of his Ship and of the Elements which ſurround him, ſo as to make them contribute to the accompliſhment of his deſign: but he muſt firſt be perfectly well acquainted with their power and their effects. The firſt Problems, offered for ſolution, concern the manner of getting under ſail, when the Ship is riding head to wind where there is no current; to get ready with a ſpring; to either tack or wear a ſhip: to lie to, or otherwiſe diſpoſe the ſails, ſo that, by their oppoſing and counteracting each other, the ſhip may be rendered as it were immoveable: to lie to in a gale of wind, which is done by keeping as cloſe as poſſible to the wind under a ſingle ſail. And, as ſhips are never brought to, but when compelled from ſtreſs of contrary winds, there are hardly any of thoſe operations but are liable to failure. Mr. Bourdé has endeavoured to remedy theſe

 defects,

defects, by discussing each separately, and by pointing out, at the same time, the methods least liable to such inconveniencies.

The Author's next concern is how to chase a ship and come up with her by the shortest method. Several geometricians have treated before of the curves of pursuit, and of the various methods of coming up with a ship. Mr. Bourdé advises to tack as often as the chaser shall find the vessel he is chasing perpendicular to his course; provided, however, the chaser be to leeward of the other: but, if he be to windward, he must take care to keep himself standing from the vessel he is chasing always on the same *rhomb* as he did when he began the chase; which is the only means of coming both together to the point of section of the two courses.

After having chased, the next object is Boarding: therefore all the necessary evolutions to succeed in boarding, or to avoid being boarded, come after those we have been speaking of. Then Mr. Bourdé treats of the various Anchorings; such as to anchor in fine weather, the ship being close-hauled: to anchor with the wind aft: to anchor by scudding under a fore-sail, in stress of weather: to anchor with a spring, in order to present the vessel's side suddenly to a place or a ship meant to be attacked. All these operations are first described, next demonstrated, then closed with such judicious reflexions and circumstances as appear extremely necessary.

The Third Part of this Work contains various observations on Ships; such as their different parts, their construction, interiour management, rigging and stowing, the sea-service, the necessary exercises for the manœuvre, and the preparatives for an engagement: lastly, the complement of men on board, their several duties, and other important objects relative to navigation. Little as yet had been written on these matters, notwithstanding the important use of discussing, investigating, and improving practical experiments, whence every one is to hope for that experience which is too

frequently

frequently to be acquired only by time and particular circumſtances. How many unforeſeen accidents have happened, and might have been prevented, had Officers tranſmitted us their knowledge in that branch, as Mr. BOURDÉ has done!

ANOTHER object, on which Mr. BOURDÉ dwells particularly, is the method of rightly fixing in the *point-velique* the centrical force of the ſails. By the *point-velique* is underſtood that point where a perpendicular raiſed from the center of gravity of the ſurface of the floating line, meets the direction of the impulſe of the water on the Prow of the Ship in a direct courſe before the wind. This point of meeting does not take place in oblique courſes: for which reaſon, in ſuch caſes, there can be no perfect maſting of ſhips, becauſe there is no ſhip but drives and inclines. But it is however very advantageous to place the center of the force of the ſails at that height where an horizontal plane is interſected in the axis of the ſhip by the two lines above mentioned, in paying attention to the oblique courſes, which of all others are thoſe that are moſt frequently requiſite: the reſult of which tends evidently to a general ſhortening of all the maſts, yards, &c, of ſhips, as Mr. BOUGUER propoſes in many places of his Works.

THE Fourth and laſt Part of the SKILFUL SEAMAN is intirely taken up with *An Eſſay on Naval Evolutions*, accompanied with ſome Plates, on which the chief of them are delineated. In that Part are deſcribed, the Diviſion of Fleets; the Orders of Convoy, of Sailing, of Battle, and Retreat; the method of drawing up in any Order, and that of changing it; that of changing from one Order to another, when occaſioned by the ſhifting of the wind, or required by the ſituation of the Enemy; the method of manœuvering a Fleet in its various Orders without changing them; that of avoiding an Action, or of forcing the Enemy to come to one; and that of doubling on the Enemy, and of forcing or traverſing his Line.

All these various Evolutions have already been almost completely treated of by Father Hoste, towards the end of the last century: but this Work is become so scarce, that it is very difficult to be procured. On the other hand, Mr. Bourdé has added to it many things relative to the actual and modern practice of the Art, especially on the Order of Convoy, which is of the greatest use, and yet had been very little noticed by Father Hoste. The Treatise lately published by Mr. Bigot de Morogues contains also many remarks on Evolutions; but he has been most diffusive on the use of Signals: therefore the Work of Mr. Bourdé will be of service to the Public, even with regard to Evolutions.

From these circumstances, We are of opinion, that this Work is well worthy of publication, both on account of the mathematical principles of manœuvres which are therein explained with perspicuity and method, as well as the particular experiments and rules of practice with which it abounds; and we consider it as highly deserving the approbation of the Academy.

CLAIRAULT & DE LA LANDE.

I certify, that the above Extract is a true Copy of the Original, and conformable to the Judgement of the Academy.

Paris, *May* 23, 1764.

GRAND-JEAN DE FOUCHY,
Perpetual Secretary to the Royal Academy of Sciences.

AN

ESSAY

ON

NAVAL TACTICS.

PART THE FIRST.

On the Theory of Working Ships at Sea.

THE THEORY, of which this Part is compoſed, is nothing but the Demonſtration, ſupported with Proofs, of the effects of every Sail, and of the Rudder, each ſeparately or all together conſidered, both with reſpect to the points where theſe machines are placed in the Ship, and with reſpect to the different diſpoſitions which either are given them in the changes of evolutions, or reſult from their various obliquities, when they preſent more or leſs obliquely their ſurfaces to the action of the water or the wind.

LEMMA.

LEMMA.

1. *If a Body strikes a Surface, it communicates to it all its perpendicular motion.*

DEMONSTRATION.

If the Body C, (fig. 1.) meets the surface A B, with a motion perpendicular to its middle, or center of gravity D, it will do it with the strength of all its perpendicular motion, which is the produce of its weight by its velocity; and will force it in the direction D G, perpendicular to A B. If the same Body meets the same surface obliquely, and with the same velocity, it will impel it in the direction D G, with no greater velocity than that of D E, which is equal to the angle of incidence H F. For, H F expresses the perpendicular velocity of the Body H, towards the surface: which will appear evident, if we consider that the movement H D, is composed of the two movements H F, and H E; and that there is no other movement but H F, only which can meet the surface A B, since the other H E, is parallel to it.

But the part H F, of the motion of the Body H, is perpendicular to the surface A B: whence it results, that the Body H, impels in the like perpendicular manner that surface in the direction D G, with a force equal to the product of its weight by the velocity H F. —*Q. e. d.*

CHAPTER I.

Of the action which Water or Wind have, by their pressure, on surfaces.

2. FLUIDS are formed of an infinite number of particles, the minuteness of which is the cause why, in the first instant of their action, they communicate, by their shock, but very imperceptible degrees of motion: and such is the weakness of their operation, that it requires to be repeated a great many times before they can produce any sensible effect on the bodies they are to move.

IT is easy to conceive, that the more specific gravity a Body is possessed of, the stronger its impulse must be: therefore Water, which weighs nearly eight hundred and fifty times as much as Air, ought to produce (allowing the velocity to be the same) an impulsion eight hundred and fifty times as great as the Air would against a surface of the same size moved in directions perfectly similar. And when it is known that the impulse of a fluid depends on its specific gravity, it will be easily understood that such an impulse must depend also on the extent of the surface which is struck. For, it is plain that the greater the surface is (granting the gravity, the velocity, and the direction of the fluid to be the same), the stronger the impulse will be, admitting still the same proportion to be kept between the extent of that fluid's surface and that of any other surface put in comparison with it; for this only evident reason, that a surface of twelve feet square will always receive twelve times as much impulsion as would a surface of only one foot square. We must not forget, however, to observe here, at the same time,

that ſuch parts of the fluid as ſtrike, find more or leſs difficulty to recoil after the ſhock, according as the ſurface is more or leſs extenſive; becauſe, the greater the ſurface ſtruck, the longer is the continuance of repulſion from their former directions impreſſed on the particles, which, by that very act of repulſion, receive a new direction, by which they are made to loſe for a while the firſt movement they had during their primitive ones; whence it follows, that the ſhock of the ſubſequent particles muſt be altered: but, after all, this deviation, from the direct line, of the ſubſequent particles, is ſo trifling, that it may almoſt be looked upon as nothing; ſince there is very little wanting, indeed, but all impulſions ſhould be intirely dependent on, and comparable with, the reciprocal proportions which happen to exiſt between them and the ſurfaces on which they ſtrike; allowing always all other circumſtances to be alike.

3. It muſt be obſerved, that the rapidity of the fluid contributes doubly to the force of the impulſe; ſince every particle ſtrikes with ſo much the more ſtrength as it acts with a greater velocity, and is at the ſame time followed by a greater number of new particles to ſhock the ſurface. So that the greater the celerity of the particles, the greater is the number of thoſe which ſhare the action, and the more powerful is the reſiſtance they oppoſe to their being put out of their direct motion. But, if the Fluid is poſſeſſed of five or ſix times more rapidity, it is evident that every particle enjoys likewiſe five or ſix times more force to ſhock the ſurface which oppoſes the paſſage of them all together; as, on the ſide of the ſurface, there are five or ſix times as many particles to encounter in the ſame ſpace of time: therefore ſuch a ſurface, thus expoſed to the ſhock of the fluid, will be ſtruck with twenty-five or thirty-ſix times more force at one time than at another, ſince there are five or ſix times as many particles employed in the act of ſtriking, and ſupported with five or ſix times as much rapidity. Whence it may be drawn

as

as a conclusion, that impulsions increase as the squares of velocities; or, in other terms, that they are between themselves as the squares of their velocities, when all other circumstances are the same.

OBSERVATIONS.

When a surface is exposed to the course of a fluid, it is indifferent whether we consider that fluid as shocking the surface, or the surface as moving in the fluid: or, again, whether we consider the fluid and the surface as having each their respective share of the velocity with which that surface receives the impulse of the fluid.

4. When the Wind has little velocity, its action is observed to be but faint; but, when moving with rapidity, then it becomes capable of producing the greatest effects. This is not difficult to be conceived; for, if to the action of every particle of air, which is stronger on account of its increased celerity, be added a greater number of particles striking at the same time, it is evident that its force will increase as the square of its velocity; which has already been demonstrated.

The same, therefore, may be said of Water, the impulse of which is almost like that of a solid when it acts, or is acted upon, with a great rapidity of motion. Whence we must conclude, that if that water meets perpendicularly a body which presents to it a great superficies, such a body must have the greatest solidity to be able to resist it.

5. This principle is confirmed by experience. For, a ship which drives to leeward does not divide the fluid with her side in a direct line; there is always some obliquity in the direction she pursues by her act of dividing. Now, this obliquity proceeds from the little resistance she experiences from the fluid either at her stem or at her stern. So that should she be but ever so little driven to leeward, she glides always obliquely on the column of water which

opposes her, under her lee, in following a line more or less close to the direction of her length, than to the perpendicular which may be conceived to be drawn as lateral to her keel.

6. We have, as yet, spoken of the impulse of fluids upon surfaces only, when considered as perpendicular: but, when that impulse becomes oblique, it is plain it must receive a great deal of diminution; since the motion of every particle will be discomposed on account of its acting only by its motion perpendicular to the surface, as has been demonstrated (*fig.* 1.), where the body H, may be considered as a particle of a fluid, the impulse of which is proportionably less as the sine of the angle of incidence H D F, is diminished: therefore, in this present case, when we consider the particle H, as a body, its impulse will be in the proportion of the different angles of incidence, which always express the respective velocities, these being considered in a direction perpendicular to the surface.

7. If, instead of a particle only, the whole surface is considered as exposed to the course of all those which compose a fluid; it will appear evident, from what has been said, that the surface E F, (*fig.* 2.), which is oblique to the course of the fluid, presents to that fluid, a less surface than it would if it were perpendicular to it, like A B. So that each particle produces a less shock, and less in number are the particles which are at the same time contributing their share to the shock. Now, as these two causes of diminution follow the same proportion, it results, that the impulsions of fluids are between themselves as the squares of the sines of incidence. Therefore, as soon as the impulse of a fluid, which strikes a surface perpendicularly, is known; you have only to diminish that impulse, when it strikes the surface obliquely, in the same proportion as the sine total I K, is to the square of the sine of incidence L K.

The surface A B (*fig.* 2.) receives all the direct impulse of the fluid which strikes it perpendicularly, and which is contained be-

tween

tween C D: but, the ſame ſurface, preſented obliquely to the fluid in the direction E F, will receive but a part of the impulſe, which will be proportional to the ſine of incidence K L, compared with the ſine total I K, of the direct effort of every particle contained between the parallels E G, and F H, which incloſe a much leſs ſpace than the firſt, A C, and B D. Whence we may eaſily conclude, that the diminution of the impulſe of the fluid has diminiſhed on two ſides, and has conſequently followed the proportion of the ſquare of the ſine total I K, to the ſquare of the ſine of incidence L K; for, there is a leſs number of particles employed in ſtriking the ſurface, and poſſeſſed of a ſmaller degree of velocity.

COROLLARY.

8. It follows, that we ought not to be ſurpriſed to ſee the velocity of a ſhip diminiſhing conſiderably when, after having run with the wind aft or large, the veſſel is hauled cloſe on a bowline. For, it is evident that all the ſails which can poſſibly be ſpread in this laſt direction will receive but very little impulſe, on account of their great obliquity to the wind, with which they cannot make an angle more open than 30 degrees, and ſometimes much leſs, as will be demonſtrated hereafter. So that the impulſe has diminiſhed, in proportion as the ſquare of the ſine total is to the ſine of incidence of 30 degrees; that is to ſay, as 4 to 1. Therefore, the ſails, receiving but a very faint impulſe, can neceſſarily communicate to the ſhip but a ſmall motion; a motion which is ſtill enfeebled by the reſiſtance of the water on the prow; which reſiſtance increaſes, on one hand, by the inclination of the ſhip, and on the other by the greater ſurface which ſhe preſents to the water in the direction of her length; to which muſt be added, again, the decompoſition of the abſolute effort of the ſails, the lateral part of which is now become much greater than the direct. By all

all these means we see, that the rapidity of the ship's way is already diminished from three evident causes; to which a fourth may still be added; and is this: that if the ship has an inclination to the horizon (as this never fails to happen in oblique courses, and as we have already hinted), and if the wind has ever so little force, there will result again, from that new circumstance, a fourth cause of diminution of impulse of the wind on the sails; because, in such a case, the sails follow that particular inclination of the ship called *heeling:* and this diminution of impulse will follow this particular proportion, *viz.* that in such a direction the square of the sine of incidence will be smaller than that of the sine total. Therefore, we see that the absolute sine of incidence diminishes in a twofold proportion, and receives that diminution from the compound ratio of the proportion which the sine total bears to the two sines of the obliquity of the yard with the wind, and of the inclination of the sail with the wind.

REMARKS.

9. THE impulse of the wind on the sails being continual, must necessarily communicate to the ship, degrees of velocity which, from instant to instant, are increasing, until there happens to be an equilibrium between the impulse of the wind on the sails and the resistance of the water on the prow; observing also, that in the courses where the ship sails with the wind abaft the beam, the first moment when the wind strikes the sails, is the time when its impulse is greatest, and the resistance of the water the weakest; because, at that instant, the ship does not yet move in the fluid, not having yielded to the power of the wind: but, in a few moments, the ship gathering way, her velocity increases, whence the resistance of the water on the prow increases, also considerably: then the impulse of the wind on the sails is proportionably decreasing; because the ship receding,

ceding, as it were, from the wind, muſt of courſe leſſen its power on the ſails. Thus the accelerating force is inceſſantly leſſening from two cauſes; the firſt from the wind ſtriking the ſails with leſs force, and the ſecond from the greater part of its impulſe being deſtroyed by the reſiſtance of the water on the prow: a reſiſtance which increaſes in proportion as the ſhip's way accelerates; for, this oppoſition of the water is as a deduction from the effort of the wind; ſince, by its reſiſtance, the water renders part of that effort ineffectual. Therefore, the rate of ſailing will be the greateſt poſſible when the impulſe of the wind upon the ſails ſhall be ſo diminiſhed, and the reſiſtance of the water on the prow ſo increaſed, as that the two forces acting in contrary directions are in a perfect equilibrium. Hence we are to conclude, that the veſſel muſt now enjoy a conſtant and uniform motion; for, the ſhip advances as if ſhe were not ſubject to the action of any exterior force, the wind no longer having power to increaſe her velocity, becauſe the reſiſtance of the water on her prow prevents it; and, on the other hand, the impulſe of the wind hinders the water, by its reſiſtance, from retarding her courſe.

OBSERVATIONS.

10. If a ſhip runs on a line perpendicular to the direction of the wind, the impulſe on the ſails is always the ſame, becauſe ſhe does not recede from the point from which the wind blows: but, when ſhe ſails cloſe hauled, the impulſe muſt be ſtronger; becauſe ſhe runs to windward, and draws nearer to that point. So that if the rate of the ſhip's ſailing be great, the apparent angle of incidence diminiſhes in proportion to the two velocities, *viz.* that of the wind, and that of the ſhip.

The moment a ſurface which is ſuſpended, or afloat, is ſtruck by a fluid, that is the time of the greateſt impulſion (if it were not in motion before), and of the greateſt reſiſtance of the ſurface.

CHAPTER

CHAPTER II.

Of the Center of Gravity.

11. EVERY ſolid has a center of gravity; that is to ſay, a point on which, it being ſuſpended, it will have a perfect equilibrium in any poſition. And on that point all the gravity of the body is united. For example, in the rectangular parallelepipedon A B, (*fig.* 3.), the center of gravity of which is exactly in the middle G; if it be ſuſpended from that point, as from G, to D, it will always be in equilibrium; becauſe that ſolid being conſidered as regular, one of its halves muſt exactly balance the other; and were it not regular, the finding of this center would be much more complicated. Without engaging, therefore, in abſtract difficulties, it will be ſufficient, for our purpoſe, to make it appear that the center of gravity of a body heavier at one extremity than at the other, lies always in the heavieſt part, with reſpect to the point which marks the middle of the length of the body. If to the ſolid A B, which is ſuſpended in a perfect equilibrium by its center of gravity G, be added a weight E, in the center of the part A G, the equilibrium will then be loſt, as it will increaſe the weight of this part, which will then overweigh the other half B G, by all the weight E, of which the part B G, becomes by ſo much lighter. To find, then, the center of gravity, which is changed from G, to I, we muſt divide reciprocally to the weight of the two bodies, A G + E for the one, and B G, for the other, the interval F H; for it may be ſuppoſed that this half A G, of the parallelepipedon (*fig.* 3.) *plus* the weight E, is a body ſuſpended by the center F, of the part A G;

and

and that this point is the extremity of a lever F H, infinitely light, which bears alſo, at the other extremity H, taken for the center of the other part B G, all the weight of that part: ſo that, if the body A G+E, weighs four times as much as the other weight B G, we have but to make the interval F I, the fourth part of the other I H, and the point I, will then be the center of gravity required of the ſolid A B+E, and the two bodies ſuſpended by that point will be in perfect equilibrium; for the weight A G+E, is four times as heavy as the other B G; but it acts with an arm of a lever F I, which is only the fourth part of the other I H; therefore the two weights ſuſpended by the point I, will preſerve a perfect equilibrium, in whatever ſituation they may be placed, as they make, in fact, both but one, the heavineſs of which may be ſuppoſed united in the ſingle point I, which is the center of gravity ſought.

COROLLARY.

12. It follows, from what has been demonſtrated, that a long lever is productive of a greater effect than a ſhort one, when both are actuated by the ſame force; whence we muſt conclude, that the longeſt lever, or (what is the ſame) the greateſt diſtance from the *fulcrum* or point of ſupport, is proportional to the greateſt weight.

It is very eaſy to be convinced of this truth, if we make one of the two following proportions: firſt, thus; the ſum of the two weights A G+E+B G : F H :: B G : F I; or :: A G+E : I H.

We have ſuppoſed the weight A G+E (*fig.* 3.) to weigh four times as much as the other B G, which I ſuppoſe to be two pounds; ſo that the ſum total will be ten pounds. Then ſay: Ten, the ſum of the two weights, is to the whole lever F H, as two pounds is to the leſs part F I, of the lever divided into five equal parts: ſo that, if F I, is equal to two feet, I H, will be equal to eight feet, and F H, equal to ten feet. But we have alſo this

proportion to make; *viz.* TEN pounds, the ſum of the two weights, is to ten feet, the length of the whole lever, as eight pounds are to eight feet; but, admitting the diſtance F H, to be ten feet, the diſtance F I, is found to be two feet, and that of H I, eight feet; which demonſtrates, that a power of two pounds on a lever of eight feet, is equal to a power of eight pounds on a lever of two feet; for, the product of the extremes, in both the one and the other proportions, is equal to that of their means.—*Q. E. D.*

IT ought alſo to be obſerved, that the center of gravity of a ſolid follows always the greateſt weight with reſpect to the middle G, (*fig.* 3.), ſince the point I, is four times as near the center F, of the heavieſt body as it is to the center H, of the lighteſt body.

COROLLARY.

13. IT follows, that the center of gravity A, of a ſhip (*fig.* 4.) is always before the point C, which is the middle of her abſolute length; for, the fore part B C, having more capacity than the after part C D, muſt of courſe have alſo more weight: therefore, it carries the center of gravity C, forward, in proportion to its greater weight (which in large ſhips is from fifty to eighty tons), and to the interval there is between every center of gravity of each particular part, both forward and aft.

REMARKS.

14. WHEN at ſea, and the ſhip loaded, the center of gravity may well be ſuppoſed to be no longer ſubject to change, unleſs the cargo be moved.

BUT we muſt not neglect to obſerve, that, as experience ſhows it, the fore or after part of the bottom of a ſhip plunges and labours more and more, in proportion as the wind acts with more or leſs force

force on the ſails; becauſe ſhips are generally not maſted according to the *point velique:* * ſo that a ſhip which has the center of the effort of her ſails ill-placed, draws always more water forward or aſt, when the wind acts powerfully on her ſails, than when ſhe is at eaſe under her burthen.

THEOREM.

15. *The center of rotation, or the point on which a body turns freely, is always on the other ſide of the center of gravity of that body, with reſpect to the point on which the moving force is acting.*

DEMONSTRATION.

If the body B D, (*fig.* 5.) be ſtruck in its center of gravity G, when it is in a perfect ſtate of reſt, it is evident (n. 1.) that the two extremities B, and D, will advance equally on parallels: but, if it is ſtruck in the point F, diſtant from the center of gravity by any mobile ſuch as A, when it is ſubject to no friction, it will then have two motions with reſpect to its center of gravity G, on which are collected all the weight and the reſiſtance. For, that center, not being held by any thing, is moved in the direction G *g*, parallel to the direction A I, of the effort of the mobile A, which ſtrikes the

* Let an horizontal ſection of the ſhip, at the exact height of the floating line, or where the ſurrounding filaments of water encompaſs the bottom, be ſuppoſed; from the center of gravity of this ſurface, let a perpendicular be raiſed, and continued till interſected by the direction of the impulſe of the water on the prow, in ſailing exactly before the wind; and where theſe two lines ſhall cut each other, there is the *point velique*, and where the center of effort of all the ſails ſhould be placed.

the body B D, in the point F. So that the part B G, of that body receives the ſhock of the mobile A, which makes it paſs from F to *f*, conformably to the direction of its motion A I. And as the other part G D, of the ſame body ſhares that motion but in proportion as its parts are leſs diſtant from the point F, of percuſſion, (ſince the neareſt parts of that point receive the greater ſhare of the action,) in proportion as they remove from their firſt ſituation, they all deſcribe, by the firſt effect of the ſhock, parallels B *b*, G *g*, and D *d*, to the direction A I, of the effort of the mobile A. Theſe parallels are greater as they are more diſtant from the part ſhocked, and from its extremity B; becauſe the reſiſtance which the body B D, makes againſt receiving the motion, cannot be in equilibrium with that which the power A, takes to loſe part of its own motion, but as much as the two reſiſtances are equal and directly contrary: therefore, the body B D, in yielding to the impulſe of the mobile A, does not oppoſe to it a reſiſtance equal to its ſhock; it muſt then change its place and ſituation, in turning on the point R, marked by the meeting of two lines D R, and *d* R, drawn from the center of gravity of the body B D, in thoſe two ſituations, before and after the ſhock; and as the circular motion of the body B D, takes its riſe always round the center of gravity, it is eaſy to conceive that the center having taken the velocity G *g*, it muſt continue to move equally in the ſame right line prolonged; and that the body having begun to turn, it muſt continue to do the ſame round its center of gravity, although, at the ſame time, it be carried in the direction A I, on the parallels B E, and D H, as long as the force which puts it in motion ſhall exiſt. But, it muſt be remarked that, in proportion as it ſhall remove from its firſt ſituation B D, it will loſe all the relations it had in the principle of motion, with the point R; that is to ſay, that the point G, being tranſported to *g*, in the firſt inſtant of the ſhock, it will continue in the ſecond and the following inſtants to be thus tranſported on

the

the ſame line and in the ſame direction: therefore, the point of rotation R, will change in proportion as the body B D, removes from the ſecond ſituation *b d,* to take another E H; for the line H K, will cut D R, of the firſt ſituation B D, in a point K, nearer the point from which the body was moved; and although the point of rotation R, be continually changing during the time of motion, it remains always on the other ſide of the center of gravity, with reſpect to the point of percuſſion, till at laſt the body B D, be ſo much turned, that the effort A I, may paſs through the center of gravity G, in the direction D B; then the body D B, will ceaſe to turn round a point ſituated on the part G D, prolonged, and will turn ſucceſſively on different points of the part G B, which will then have paſſed to the oppoſite ſide.

REMARKS.

16. IF the force of the mobile A, (*fig.* 5.), employed to turn the body B D, be greater or leſs, the velocity G *g*, of the center of gravity will be likewiſe increaſed or diminiſhed in proportion as the mobile ſhall act with more or leſs power. Conſequently, when the body B D, changes its ſituation, the angle it will make with its firſt poſition will be proportional to the motion G *g*, or to the force employed in the ſhock, ſince they are correſpondent to one another. Therefore, all other circumſtances being the ſame, the rapidity of the circular or turning motion will be always in proportion to the force employed to procure it.

17. A METHOD of increaſing the rapidity of motion, and the angle of rotation, is to make the power A, (*fig.* 5.) act on a point more diſtant from the center of gravity G, than the given point F; for, it is clear, that if the diſtance G F, be two or three times augmented, the other diſtance G R, from the center of gravity to the point of rotation, will become two or three times leſs; and the

ſides

ſides of the angle G R g, becoming conſequently ſhorter, it follows, that the angle will of courſe be more open in the ſame proportion. Therefore, it may be demonſtrated that there are two ſure and infallible methods of augmenting both the angle and motion of rotation of a body: the firſt, is by employing more force in the percuſſion, in order that the angle G R g, ſhould be as much increaſed as is the ſide G g, which ſubtends it.

THE ſecond, is to apply the force at a greater diſtance from the center of gravity of the body you wiſh to turn: for, in augmenting F G, G R, is diminiſhed; and the more the ſides which form an angle are ſhortened (the ſide which ſubtends it ſtill remaining the ſame), the more the angle is augmented. So that the angle of rotation is in a compound proportion both to the force employed, and to the diſtance of that force from the center of gravity: this angle is then, as the produce of that force multiplied by F G. Although the body be perfectly free, and take a direct motion G g, we muſt conſider its center of gravity G, as the point of ſupport, or F G, as the arm of a lever; and the angle of rotation B R b is always proportional to the *abſolute** force, employed in the percuſſion.

18. LET us conſider the body B D, (*fig.* 5.) as being expoſed to the action of ſeveral forces at the ſame time, and it will ſoon appear that the angle of rotation will be proportional to the ſum or difference of the abſolute forces, according as they tend to turn the body B D, in the ſame or in contrary directions.

IF the operative forces directly counteract each other, it is plain their abſolute effect, with reſpect to the center of gravity G, muſt be firſt ſought, and then deduct the exceſs of one from the other: this

* By the term *abſolute force*, we underſtand the force employed to turn the body, multiplied by the diſtance F G, from the center of gravity.

this being done, the angle of rotation will be in a ratio to that excess; whereas it will be proportional to the sum of the forces employed, if these act in concert, and in the same manner, to augment it.

But if you take no notice of the angle of rotation, and wish to consider the center of gravity only as being transported from G, to g, it is not necessary to seek the sum of the absolute forces of the acting powers: you have but to consider the forces in themselves, and then G g, will be found proportional to either their sum or their difference, according as they contribute to produce the same effects, or as they are opposite in their efforts.

Are those forces equal between themselves, and do they act in contrary directions on the extremities A, and B, (*fig.* 6.) of the body A B, and on arms of equal levers? Then it is evident the angle of rotation will be double what it would be, if the body was struck by only one of these forces, and turned on its center of gravity: since the two parts, which stand separated by the center, are struck equally, and at the same time, by forces which act perpendicularly in contrary directions.

To prove this, observe that the equal powers S, and T, are acting at the same time on the body A B, with equal levers G K, and G F: so that the extremity B, passes to C, at the same time as the extremity A, passes to D; and thereby the center of gravity G, remains as if it were fixed in the same point which serves as a center of rotation; for, if one of the acting forces removes it from its first situation, the other, in opposing an equal force, will replace it.

If the power T, exceeds the other S, it is evident the center of gravity G, will be transported towards g, in proportion as the force T, exceeds the other S; then the body A B, could turn no longer on the center of gravity G, (n. 15.), but on another point E, which would be on the other side of the center of gravity G, with respect to the point of percussion.

OBSERVATIONS.

OBSERVATIONS.

If the body A B, (*fig.* 6.) were ſtruck at the two points K, and F, by two mobiles S, and I, exerting equal powers, with reſpect to the center of gravity G; it is plain that the body A B will be carried on parallels, ſuch as I T, and S H, and that the ſum of the two powers will act on the center of gravity G, ſince they are equal in every reſpect.

THEOREM.

19. *A ſail acts always two ways on a ſhip, when it is not perpendicular to her length.*

DEMONSTRATION.

To prove it, we have only to conſider the ſail A B, (*fig.* 7) oblique to the ſhip and to the wind W, to be convinced (nn. 1, 7.) that it is impelled in the direction C D, with a force expreſſed by the ſquare of the ſine of incidence of the wind upon the ſail. Therefore, what we are going to ſay here for the preſent caſe is to be underſtood as applicable in all others, in which the ſail ſhall not be perpendicular to the length of the ſhip; for, then, ſhe would go but in the direction of her length from C, to E, or from C, to F, according as the ſail might be full or a-back.

If C D, be equal to the impulſe of the wind upon the ſail, as expreſſed by the ſquare of the ſign of incidence A V, we have only to form the right-angled parallelogram G H, to be convinced that ſuch a direction is compoſed of the two effects C H, and C G, which it produces with reſpect to the body E F, upon which it acts in impelling it in the direction C D.—*Q. E. D.*

REMARKS.

REMARKS.

The more the yard A B (*fig.* 7.) ſhall make the angle A C E acute, the more the effect C H will augment, and the other C G diminiſh; for, the more the angle A C E becomes acute, the more its equal D C H or C D G (n. 22) will be acute alſo; ſo that the perpendicular C D, which is in the direction of the center of the yard, will approach more to the other perpendicular C H, in the direction of the length of the ſhip E F; which cannot happen without increaſing the effect of the ſhip falling off in the direction C H, and increaſing likewiſe the cauſe C D, which follows in that increaſe the ſame proportion as the ſquare of the ſine of incidence augments (nn. 1, 6, 7.). But this increaſe of the impulſe C D is not ſufficient to preſerve the effect of the ſail in the direction of the keel C G. On the contrary, it diminiſhes in the proportion of the decreaſe of the ſine A C E or C D G; whence it follows, you never can augment the impulſe of the wind by ſhifting the ſituation of the ſail, when it is properly trimmed, without leſſening the rate of ſailing (n. 28.), when neither the ſhip changes her courſe, nor the wind ſhifts its ſource or direction.

20. It might, in the ſame manner, be demonſtrated, that the more open the angle A C E of the ſail is with the keel, the more its effect C G, in the direction of the ſhip's length, will increaſe in the ſame proportion as the increaſe of the ſine of that angle, when the impulſe of the wind upon the ſail is the ſame; for, the ſines of the angles are in proportion to their oppoſite ſides in the triangle C D G, of which the angle C D G is equal to the angle A C E.

If the impulſe augment alſo (n. 3.), the two effects C G and C H will augment proportionally.

21. If the ſail A B receive the impulſe of the wind B on its anterior ſurface, it would ſtill act in two ways on the ſhip, by

 forcing

forcing her first a-stern in the direction C F, and then to leeward in the direction H C: To prove this, reverse the parallelogram, by tracing it on the after part of the yard A B, which looks to the side F, and use the same reasoning.

THEOREM.

22. *The angle* A C F (*fig.* 8.) *formed by the yard* A B, *and the keel* F C *of the ship, is equal to the angle* D C E *comprehended between the perpendiculars* D C *to the yard and* E C *to the keel, in the like manner as the angle* C D G.

DEMONSTRATION.

THE angle A C D is right, since C D is perpendicular on A B: the other angle F C E is right also; for C H is perpendicular on F C I; therefore, the arc A D is equal to the arc F H; and if, from these two equal arcs, be taken away the common one F D, the remainders A F and H D will be equal: because, when equals are taken from equals, the remainders must be equal.—*Q. E. D.*

SECONDLY, the angle C D G in the parallelogram G E is alternate to the angle D C E: therefore it is equal to it; therefore it is equal to A C F.—*Q. E. D.*

COROLLARY.

23. IT follows that the angle B C H is equal to the angle D C F; for, if, from the two equal arcs A D and B D, be taken the other equal arcs F A and D H, the remainders F D and H B will be equal.

REMARKS.

REMARKS.

24. THE few principles of Geometry here given, and which will be found of great service in the sequel, ought not to discourage. When we make use of them now, it is only that we may establish principles as simple as they are sure and fundamental, and leave nothing to doubt or conjecture in the following part of this Theory, which is in itself very abstruse. We shall however be obliged to use again a few more demonstrations of this kind.

CHAPTER III.

Of the most advantageous angle the sails are to make with the keel and the wind, in order to obtain a sailing of the greatest rate, on an oblique course.

25. IN most ships the sails make with the keel an angle ADR (*fig.* 9.) of 40 degrees, or thereabouts (some more, some less), when close hauled. We are now to undertake to make it appear that this angle is not the most favourable to run with the greatest velocity, in getting to windward. It should be much more oblique; but as it is not possible, in practice, to attain the greatest perfection, for very essential reasons, such as the solidity of the masts, yards, &c &c, we must be contented to approach it as near as possible, in great ships, by reducing the angle ADR to 30 degrees only. This will be so much the more easily done, as in every ship the two foremost shrouds of each lower mast can be suppressed. For it

must be observed that in the movement of pitching and rolling, the masts always incline forward, in the direction D E of the effort of the sail; so that the shrouds which are abaft, and cat-harpened in, are sufficient to support the masts, since they act nearly opposite to the effort of the sail. Besides, should there be reason to expect bad weather, preventer shrouds may easily be fastened to the strops which are always ready hung for that purpose. This practice is so much the better grounded, as the number of those preventers can at any time be increased as circumstances or necessity require*. Therefore, we shall, for the future, consider the angle A D R, which is the most oblique in practice, as fixed at 30 degrees, though, in some ships, it may happen to be more acute: a circumstance to which the manœuverer ought to pay a particular attention.

26. AMONG all the angles A D R, B D R, and H D R (*fig.* 9.) which the sail A Z can make with the keel in the same course D R, it is evident there must be one more advantageous than the rest, to give the ship the greatest velocity possible in the most oblique course. Now, that angle of the sail and the keel is not that we propose directly to determine, since it is impossible to render it more acute than 30 degrees, which is the term to which we have fixed it in practice: but it will serve us to determine the most favourable angle of incidence A D W of the wind upon the sail, and which is the most advantageous to run with the greatest rapidity on all oblique courses between close hauled and wind abaft.

27. BEFORE

* But, should this expedient be thought dangerous or troublesome, the two foremost shrouds may be fixed with three sheave blocks instead of dead eyes, according to the French fashion. The two foremost shrouds to leeward being relaxed, would amazingly facilitate the bracing-up of the yard, which, as things are at present, is known to require a very great effort in our King's ships; and indeed it is not to be wondered at, since they are obliged to make a perfect elbow in two ropes of that size and tightness, before they can effect their purpose. These shrouds, *in stays or before the wind*, would be easily set up equally taught with the rest.

27. Before entering upon the demonſtration of the rule which muſt be followed in practice, the principle which ſerves to demonſtrate its utility muſt be firſt eſtabliſhed.

It may be recollected that impulſions (n. 7.) are between themſelves as the ſquares of the ſines of incidence. Therefore, to judge if it is advantageous to render the angle of incidence A D S or A D W of the wind upon the ſail A Z, more or leſs acute, we muſt examine if the ſquare of the ſine of incidence A F, or the total impulſion D E, increaſes more or leſs than the ſquares of the ſines of incidence B C, and H I, or than their correſpondent impulſions D G and D K, proportionally to the diminution or increaſe of the ſines of the angles of obliquity of the ſail with the keel A T, B Y, and H L: for, if the ſquare of the ſign of incidence H I, or the impulſion D K, does not increaſe ſo much proportionally, as the ſine of obliquity A T diminiſhes in becoming equal to L H, it is evident that the poſition of the ſail A D is more favourable than when it is ſituated in the direction D H: and if the ſquare of the ſine of incidence B C, or its correſpondent impulſe D G, diminiſhes more in proportion than the ſine A T augments, in becoming equal to the other ſign of obliquity B Y, in the other poſition of the ſail; it becomes an evident proof that its ſituation A D is ſtill more favourable than if it were in the poſition B D, and that there is no better ſituation than A D, whether the angle of incidence A D W be increaſed or diminiſhed.

28. To prove it, we ſhall conſider (*fig.* 9) the abſolute impulſions D K, D E, and D G, as being correſpondent with the ſines of incidence H I, A F, and B C, and proportional to the ſquares of theſe ſame ſines; then, on theſe diagonal lines, if we draw the rectangles X N and M O, in order to diſſolve thoſe total impulſions D E and D G, it will appear evident that the direct effort D X in the direction of the keel, is the greateſt poſſible, when the tangent A S of the angle of incidence is double the tangent A R of the angle of

of obliquity of the sail with the keel; for, if the angle of incidence be opened ten degrees, by placing the sail in the situation H D, it will appear that, though the total impulse D K is augmented in the ratio of the square of the new sine of incidence H I to the first A F, the partial effort D M, in the direction of the keel, will be nearly by one tenth less, in this situation of the sail H D, than in the first A D. The direct impulsions D M, which proceed from the total ones D K and D G, are equal, because these last have augmented or diminished in the same ratio as the sines H L and B Y have lessened or increased in proportion to the square of the sine of incidence A F, and to the sine of obliquity A T. These direct partial-impulsions D M and D X are in a compounded ratio of the sines of obliquity H L, A T, B Y, equal (n. 22.) to those of the angles D K M, D E X, D G M, and of the total impulsions D K, D E, and D G; for, if the total impulsion augment by a movement of the sail, the sine of obliquity diminishes: so that from the total impulsions can at any time be deduced the direct ones for every possible angle of incidence. By calculation might very well again be verified this demonstration, which proves that the tangent A S of the angle of incidence must always be double the tangent A R of the angle formed between the sail and the keel, agreeably to the situation of the sail A Z; since, if any other position be given to it with respect to the wind W, whether it be in the direction H D ten degrees more open than A Z, or like B D ten degrees more oblique, a result as D M, in the direction of the keel, will ever be found less than D X.—*Q. E. D.*

OBSERVATIONS.

As the vanes always indicate the apparent direction of the wind, on all the courses the ship can sail, the angle which the wind makes with the course, or the keel, cannot fail being easily known

if

if there is no lee way; let that angle with the ſails be parted into two others, ſo that the angle of obliquity of the ſail with the courſe may have its tangent equal to half the tangent of the apparent angle of incidence of the wind upon the ſails. On this foundation, it will be eaſy to form a table which will always ſhow both the apparent angle of incidence, and that of the obliquity of the ſail with the keel, or with the courſe. This table will ſerve for all oblique courſes, whenever the after ſails ſhall not take the wind from thoſe forward, or will do it but in a trifling degree; for, ſhould they becalm them much, they muſt, for other conſiderations, be braced up a little more to the windward; but always have the precaution to leave the apparent angle of incidence of the wind upon the ſail more open than that between the ſail and the keel, or the courſe.

ARTICLE I.

Remarks on ſailing by the wind.

29. WHEN it is neceſſary to gain to windward as much as poſſible, without abſolutely wiſhing to ſail with the greateſt velocity, let the direction of the coaſt under the lee be ſuppoſed to make with the abſolute direction of the wind (which muſt as near as poſſible be known) an angle of 90 degrees; or, in the ſea phraſe, *blowing dead on ſhore:* let the angle A C E (*fig.* 10.) formed by the ſail and the keel, be known to be 30 degrees, let the lee-way be alſo known to be 10 degrees, the angle E C I between the ſail and the courſe will conſequently be 40 degrees, which you muſt take from the total angle W C L 90 degrees; then there will remain 50 degrees, the half of which, 25 degrees, is to be taken for the abſolute angle of incidence W C E, and for its equal I C L; ſo that the ſhip A B will go 55 degrees from the wind when ſhe is cloſe hauled,

and

and will consequently recede as much as possible from the point D on the coast, the direction of which makes an angle of 90 degrees with the absolute direction of the wind W K.

BUT, if the situation C L, (*fig.* 11.) of the point D, from which you wish to move, made an obtuse angle W C L, with the positive direction of the wind W M; then, the tangent of the apparent angle of incidence *w* C E, must be made double the angle of obliquity E C I, which the sail makes with the course, at the same time that the angle I C L, of the course and the coast shall be made equal to the angle W C E, formed by the real direction of the wind W K, and of the sail F E: so that two considerations must at once be attended to. For example: the angle A C E, formed by the sail and the keel, is 30 degrees; then, according to the first principle, it will be necessary that the apparent angle of incidence *w* C E, should be 49° 6′; and if the difference between the apparent and real direction of the wind be 10°, there will be 59° 6′ for the angle which the sail E F, makes with the real direction of the wind W M: so that the angle L C I, of the course and the object stood from, must be found also to be 59° 6′, and the total angle L C W, will then be 148° 12′, adhering to the two principles of sailing with the greatest velocity, and of getting to windward of the point D, as much as possible, at the same time; while the angle L C *w*, formed by the apparent direction of the wind and that of the coast from which the ship moves, will be only 138° 12′. The yawing and the different velocities of the ship render the angle formed by the two directions of the wind, *viz.* the real and the apparent, more or less open. If the ship has more velocity at the same time, or if the course approaches more to the direction of the wind, it will appear by the vanes that the wind draws forward, and the angle of the two directions of the wind will augment. If the ship falls off, and yet still preserves the same velocity, or if her velocity decreases without altering her course, the wind will seem by the

vanes

vanes to draw aft, and the angle of the two directions will diminish; so that, whenever the ship shall have velocity or run obliquely to the wind, there will always be a difference between its real and its apparent direction. In short, if the ship run exactly before the wind, or be in any situation having no motion, there will be then no other but the real direction of the wind shown by the vanes: but, let it happen how it will in oblique courses, this is however certain, that the sails are always struck by the absolute direction of the wind; because, their position being once fixed by the braces and bowlines, it can no more change, but continues as steady as the real direction of the wind; for it is the vanes only which, being moveable, fix themselves in a middle direction between the absolute tendency of the wind and the course of the ship; whence we may easily conclude, as we did before, that the apparent direction of the wind shown by the vanes, is an intermediate one between the respective velocities of the ship and of the wind; since that direction necessarily partakes more of the greater velocity than of the less: so that, if the ship runs East, with the wind at South, having the fourth part of the velocity of the wind, the vanes will show S. by E. 6° 45′ E. for the apparent direction of the wind.

ARTICLE II.

THEOREM OF MR. *BOUGUER*.

THE velocity and real direction of the wind is C M, (*fig.* 11): suppose the ship A B, of which E F is the sail situated at pleasure, to draw the course C I, while the particles forming the current of air run in the direction C M: if, from the point I, be drawn I K, parallel to the sail E F, till it cuts the direction of the wind W K, in the point K, there will result the three points C, I, K, through

which draw the circumference of a circle C I L K, and that circumference will ſhow the extent of the forces acting on the ſhip, at the ſame time, in following the courſe C I, provided her ſail be always trimmed in the ſame manner with reſpect to her keel.

DEMONSTRATION.

The apparent or relative velocity of the wind is repreſented by I M (*fig.* 11.) in the courſe C I; and as I K is parallel to the ſaid E F, the angle M I K is equal to the apparent angle of incidence *w* C E. But to be more explicit: the wind ſtrikes the ſail with its apparent or reſpective velocity I M, (and not with its abſolute velocity, becauſe of the motion of the ſhip,) and with an angle of incidence M I K = *w* C E: ſo that, if the ſhip runs cloſe hauled or perpendicular to the direct wind W C, I M will become in both caſes ſtronger than the abſolute velocity; becauſe the ſhip will either approach to the ſource of the wind, or not recede from it. But the impulſe on the ſail is proportional to the ſquare of the velocity I M, multiplied by the ſquare of the ſine of the angle of incidence M I K, equal to the angle *w* C E (n. 3. & 7.); and the proportion M K : *ſine* K I M : : M I : *ſine* M K I, which furniſhes us the triangle K I M, ſhows us that M K × *ſine* M K I = M I × *ſine* K I M; ſquaring the two products, and ſubſtituting the ſine of the angle W K I in the room of the ſine of the angle M K I, which is equal to it, ſince they are the ſupplement of each other, we ſhall then have this other equality: *Sine* $\overline{\mathrm{WKI}}^2 \times \overline{\mathrm{MK}}^2 = $ *ſine* $\overline{\mathrm{KIM}}^2 \times \overline{\mathrm{MI}}^2$; whence it follows, that inſtead of expreſſing the actual impulſe of the wind upon the ſail by the ſquare of I M, multiplied by the ſquare of the ſine of the angle K I M, it may be expreſſed by the ſquare of M K, multiplied by the ſquare of the ſine of the angle W K I, or of its equal W C E, formed by the abſolute direction of the wind W M, and the ſail E F.

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We muſt not forget to pay a great attention to this obſervation; *viz.* that the impulſe of the wind upon the ſails is in equilibrium with the effort of the water on the prow, or that they are exactly equal and contrary when the ſhip is come to an uniformity of motion (n. 9.), as here we ſuppoſe her to be. Beſides, the impulſe of the water on the prow is proportional or equal to the ſquare of the velocity of ſailing CI (n. 3.); ſo that the ſquare of the velocity of ſailing CI, is equal to the actual compulſion of the wind upon the ſail expreſſed by the ſquare of KM, multiplied by the ſquare of the ſine of the angle WCE; and if S be ſuppoſed equal to the ſine of WCE, or of WKI, we ſhall always find $\overline{CI}^2 = \overline{S}^2 + \overline{KM}^2$. The firſt term in this equality repreſents the impulſe of the water on the prow, and the ſecond expreſſes the effort of the wind upon the ſails; and if the ſquare roots of the one and of the other be taken, it will be found $CI = S \times KM$; that is to ſay, that the very velocity of ſailing CI, will be continually equal or proportional to the product of KM by the ſine S of the angle WCE or CKI. The proportion between theſe quantities depends on the denſity of the two fluids, and on the magnitude of the ſurfaces ſtruck: but it will be the ſame in all the different courſes.

The different velocities of ſailing CI, have a conſtant and given proportion with the products $S \times CK$ and $CI \times$ *ſine* CIK; for, the triangle CIK gives $S : CI :: $ *ſine* $CIK : CK$, which forms this equality, $S \times CK =$ *ſine* $CIK \times CI$; and all the angles C, I, K, are conſtant, and known, ſince they are equal, being alternate to that which the ſail makes with the courſe. But, as the velocity CI bears a continual and conſtant proportion with the product $S \times KM$, and as it bears alſo a conſtant proportion with $S \times CK$, it follows that $S \times KM : S \times CK :: KM : KC$; ſo that the point K always divides CM in the ſame proportion: the point K is then invariable when the ſail, as well as the lee-way, are both the ſame; (which never happens, however, as will be made appear (n. 47.) hereafter): but,

in admitting those two hypotheses, which never can deviate from the truth but in respect to the lee-way, which is always variable in the same ship, according to the different circumstances of wind, sea, velocity, sail, and course, it ought then to be concluded that all the points, I, &c, &c, will be situated on the circumference of a circle; for, without that, the angle C I K equal to those which are formed by the sail and the course, and which are supported on the same chord C K, would not be equal.

COROLLARY.

It follows (*fig.* 11.) from that the velocities are continually proportional to the sines (whatever they be) of the angles W C E, which the sail makes with the absolute direction of the wind, provided the sail be always trimmed in the same manner with respect to the keel, and that, in the triangle C I K, the side C K and the angle C I K are constant, and the velocities of sailing C I are proportional to the sine of the angle C K I equal to the angle of incidence W C E: it follows, I say, that all the other conditions being the same, the more the sine of the angle W C E is augmented, the greater therefore will the rate of sailing be; so that, if you want to carry it to the greatest rapidity, you have only to make a right angle of the angle W C E formed by the absolute or real direction of the wind with the sail; then the velocity C I will no longer be a simple chord in the circle C K I, but a diameter. This holds good for all the ships which have but one sail set; but, whenever they shall have several, the greatest velocity will be when the apparent angle of incidence of the wind upon the sail makes a right angle with the course; because then the sails will easily make with the apparent wind, an angle, of which the tangent will be double that of the angle they make with the course, without their becalming one another; while, at the same time, the ship will receive all the abso-

lute impulse of the wind, because she does not recede from it, and it is the time when the greatest surface of sail is exposed to its action. The same advantage of the greatest velocity will still be had, when the apparent direction of the wind makes an angle of a hundred degrees with the course; and I am inclined to think that, in this situation, the velocity will in some degree be increased. In a word, whenever the after sails do not becalm those forward, the ship's rapidity may always be increased, by trimming the sails as directed (n. 28.): but when the sails take the wind from one another, an increase of velocity can no longer be pretended to.

Now, we are going to demonstrate the exactness of the rule given before (n. 29.). When it is required to get off shore, or recede from a given right line with all possible expedition, or to keep absolutely as close to the wind as the ship will lie; C M (*fig.* 11.) is the absolute direction of the wind; the circle C K L I marks all the points at which the ship can arrive with the same sail, the same disposition, without alteration of lee-way, and at the same time; and C L is the right line from which she is to move. Knowing the angle that line makes with the absolute direction of the wind W M, it is evident that the point I of the circumference, where the course ought to end, is in the middle of the arc C I L, of which C L is the chord: and all the points from one part to the other of C I, where the ship can come to at the same time, are less distant from C L, since D I, perpendicular to C L, divides it into two equal parts, and is the longest of all the perpendiculars which can be drawn from the circumference C I L; but the point I, cannot be taken without rendering the angle L C I equal to the angle C K I, which itself is equal to the angle W C E.

ARTICLE III.

A TABLE of the situation of the sails to run with the greatest velocity.

Extracted from the MANOEUVRE OF SHIPS by Mr. BOUGUER.

Angles of the apparent direction of the wind and course.		*Angles of the sails with the keel.*		*Angles of apparent incidence of the wind on the sails.*	
D.	M.	D.	M.	D.	M.
180,	00	90,	00	90,	00
176,	15	87,	30	88,	45
174,	37	86,	25	88,	12
172,	30	85,	00	87,	30
168,	44	82,	30	86,	14
164,	58	80,	00	84,	58
161,	10	77,	30	83,	40
157,	22	75,	00	82,	20
153,	33	72,	30	81,	03
149,	41	70,	00	79,	41
145,	48	67,	30	78,	18
141,	53	65,	00	76,	53
137,	55	62,	30	75,	25
133,	54	60,	00	73,	54
129,	50	57,	30	72,	20
125,	42	55,	00	70,	42
121,	31	52,	30	66,	01
117,	14	50,	00	67,	14
112,	53	47,	30	65,	23
108,	26	45,	00	63,	26
a					b
103,	53	42,	30	61,	23
99,	13	40,	00	59,	13
94,	25	37,	30	56,	55
89,	28	35,	00	54,	28
84,	23	32,	30	51,	53
79,	06	30,	00	49,	06
73,	39	27,	30	46,	09
68,	00	25,	00	43,	00

N. B. The foregoing TABLE can be of no great ſervice, except in the eight laſt circumſtances under the line *a*, *b*; becauſe, in all the caſes mentioned above that line, the ſails will cover one another too much.

OBSERVATIONS.

WHEN a fine-ſailing ſhip (ſuch as will, on a direct courſe, or right before it, take a third or a fourth part of the velocity of the wind) comes to run with the ſame quantity, or more ſail, on a perpendicular to the apparent direction of the wind, then ſhe acquires a greater rapidity of ſailing with reſpect to the velocity of the wind; the angle formed by the two directions, the apparent and the abſolute, is at that time very conſiderable; it may be from 18° to 22° 30′; and if the ſhip hauls quite cloſe by the wind, the angle will ſtill be nearly the ſame; for, her velocity diminiſhes: but, as it is in ſailing by the wind that it is moſt eſſential to know the greatneſs of the angle between the two directions of the wind, let the angle between the directions of the ſhip's head on the different tacks be obſerved, without paying any regard to the lee-way, but juſt to the exact point on which the ſhip ſtands, before and after going about, when ſtrictly by the wind, neither too much to leeward nor to windward; and when you have determined that angle, from two or three obſervations, halve it, and then you will have the angle formed by the keel and the abſolute direction of the wind; by which you will know the quantity ſhe will come to upon the different tacks, and will never be deceived with reſpect to the lying on after having gone about: a miſtake pretty commonly made by thoſe who pay attention only to the apparent direction of the wind, which always makes with the real one an angle more or leſs open in a compound ratio of the greateſt velocity with the greateſt obliquity of the courſe of the ſhip, with reſpect to the direction

direction and the absolute velocity of the wind; things which vary in all ships, because they have not all the advantage of sailing with the same rapidity in similar circumstances.

CHAPTER IV.

Of the masts and sails which are before the center of gravity of a ship.

30. THE sails which are before the center of gravity of a ship, are the sprit-sail, bowsprit top-sail, the jib, the fore-top-mast stay-sail, and the fore stay-sail.

ALL these sails belong to the bowsprit, which projects out of the ship, over the stem, obliquely to the horizon. The fore stay-sail hoists on the fore-mast, which is stepped on the extremity of the keel; and the jib, and the fore-top-mast stay-sail, are hoisted on the fore-top-mast, which is raised above the last-mentioned mast. These masts carry also a sail more considerable than the former. The fore-mast carries the sail which bears its name, bent to its yard. There is a boomkin on each bow, placed perpendicularly under the extremity of the yard, when by the wind, for the purpose of extending the foot of this sail: the sheets are hauled aft to the sides of the ship. Directly over this last sail is placed another, called the fore top-sail, which is carried by its own yard, and tallied on the fore yard: it is hoisted, when wanted to be set, on the little top-mast. Now, this very fore top-sail is itself again surmounted by the top-gallant, carried by its own yard and mast, and tallied on the fore-top yard, as the sail of this is on the fore yard.

yard. There is ſtill over all this ſometimes another ſail, called the top-gallant royal-ſail, or only the royal-ſail: ſo that the three laſt-mentioned ſails, *viz.* the fore-ſail, the fore top-ſail, and fore top-gallant-ſail, may be looked upon as making only one large ſail, wide at the foot and tapering towards the head, and which can be reduced, as occaſion requires, either by taking in the royal, which is the higheſt, or by reefing the fore top-ſail, or even taking it quite in, if neceſſary, to have the fore-ſail only ſet; or by hauling the fore-ſail up, if nothing but the top-ſail is wanted. It muſt notwithſtanding be obſerved alſo, that the different parts of the whole ſail may, in certain caſes, be manœuvered differently the one from the other; as, for example, in reefing the top-ſail, or in taking in either the one or the other. But, when you want to ſet them to work all together, either for making a courſe, or performing ſome evolution, they muſt all be braced and trimmed in the ſame form, and with the greateſt uniformity poſſible. Therefore, whatever we ſhall ſay concerning one of them in any manœuvre, is to be underſtood to be the ſame with reſpect to all the reſt.

We wiſh not, however, to neglect obſerving here, alſo, that the ſails compriſed under the general French denomination of *Focs*, *viz.* the jib, ſtanding jib, fore-top ſtay-ſail, and fore ſtay-ſail, as well as thoſe compriſed under that of *Civadières*, which are the ſprit-ſail and bowſprit top-ſail, are no-ways connected with each other, any more than are likewiſe the main ſtay-ſail, the main-top ſtay-ſail, the preventer ſtay-ſail, or the main top-gallant ſtay-ſail, which are likewiſe ſails of the fore part of the ſhip's center of gravity, and the haliards of which are fixed at the head of the main maſt, the main-top-maſt, and the main-top-gallant maſt, while their tacks are at the foot of the fore-maſt, in the fore-futtocks, in the main fore-top ſhrouds, and on the top-gallant futtocks, under the croſs-trees.

ARTICLE I.

Of the effect of the Lateen sails, which are on the fore part of the center of gravity of a ship.

31. The jib and stay-sails being of a triangular or trapezoid figure, their center of gravity is easily found; and that point is to be considered as the part, in all these sails, on which the whole effort of the wind is united, when they are exposed to its impulse, whatever be the way in which it strikes them.

The effort of each Lateen sail singly being on the fore part of the center of gravity of the ship, it follows that the total effort of all these sails must be there too; and that if the ship was in a perfect equilibrium with respect to the wind, before her sails were set, she will lose it immediately after (n. 11.); they will always make the fore part of the ship obey the wind whenever it strikes them perpendicularly or obliquely. For, it must be observed, that almost all these sails have their tacks in the middle of the ship, and are tallied on the side of her; so that they make with the keel a very acute angle: whence it is easy to conceive, that a perpendicular raised on the exterior surface of these sails, in the direction of their effort to leeward, from their center of gravity, would differ but very little in the lateral direction from a perpendicular to the keel. From this we may therefore conclude, that these sails would have but very little effect to accelerate the rapidity of sailing with respect to their position, if it was not demonstrated that they are very advantageous in going by the wind. Besides, they make also the ship steer well, and are particularly useful when a ship gripes or requires a great deal of weather helm: and, when they do not take the wind out of any of the standing or lower sails, they ought to be used, particularly when one is obliged to sail by the wind, or to

run

run not very large. The jib and fore-top-maſt ſtay-ſail muſt be preferred, becauſe they are at all times uſeful when they are not hindered from receiving the wind in them: for, their poſition is ſuch, that they cannot take the wind out of any of the other ſails, and their particular effect in wearing is very conſiderable, not only on account of their great ſurface, but becauſe they act before the point, on which the ſhip turns, with a very long arm of a lever (n. 17.). On the other hand, all the ſails draw the ſhip a-head in raiſing her: for, the direction of their effort aſcends obliquely towards the horizon; therefore, (a very great advantage, which is peculiar to them) they do not make her dive in the water. Experience has, many a time, confirmed me of their utility on all occaſions when they could be employed without taking the wind out of the other ſails.

ARTICLE II.

Of the effect of the fore-ſail, fore top-ſail, fore top-gallant-ſail, and ſprit-ſail, in their different ſituations.

32. When the ſail A B (*fig.* 12.) is trimmed cloſe to the wind which blows from the point W, it is impelled in the direction C D (n. 7.) with a force expreſſed by the ſquare of the ſine of incidence, and compoſed of the two effects C E and E D (n. 19.) But, as the center of effort of that ſail A B is on the fore part of the center of gravity of the ſhip H, and as its power C D is always diſcompoſed between thoſe two effects C E and E D, it follows, that the effect of this ſail is to cauſe the ſhip to bear away; while it keeps up at the ſame time, and even augments, the rapidity of ſailing.

33. If the fore-ſail A B received the impulſe of the wind perpendicularly, it would ſtill produce the ſame effects, *viz.* bearing away, and augmenting the rate of ſailing, for the ſame reaſons juſt

given above, but more effectually (n. 29.), on account of the increase of the impulse of the wind upon the sail.

COROLLARY.

34. It follows, from what has been said, that when the sails upon the fore-mast are full, on the same side they are tacked, and braced obliquely to the keel, there is always one part of their effort, in proportion to their obliquity, which acts to make the ship bear away; while the other part of their effort acts at the same time to accelerate or keep up the rate of her sailing.

35. When the sails A B of the fore-mast (*fig.* 13.) are situated obliquely with respect to the keel, and receive the wind in them, on the side of the sheet B, they act upon the ship in bringing her then to windward, because their effort D G being discomposed, as customary, the lateral part D F carries the fore part of the ship towards the source of the wind W, in carrying her from D to F.

REMARKS.

36. In general, when the yards are square or perpendicular to the keel, it is evident they will act on the ship, only by impelling her right in the direction of the keel, from stern to head, or from head to stern, with more or less velocity, in proportion to the impulse of the fluid which strikes them.

37. When the sails A B on the fore-mast (*fig.* 14.) receive the impulse of the wind W, on their anterior surfaces, they will make the ship both go a-stern and fall off; because the direction C E of their effort, being turned towards the after-part of the vessel, serves as a diagonal to the parallelogram F D, which, by discomposing it, will show us those two effects C F and C D, the first of which takes its direction with that of the keel from forward aft; while the second takes it in a lateral direction in making the ship to turn.

REMARKS.

38. WHEN the wind blows between the keel and the yard, the ship comes to until the point G (*fig.* 14.) is in the direction of the wind W. But, as soon as this is executed, it is evident she falls off; for, the point G recedes farther and farther from the direction of the wind. Whence we are naturally led to make this remark as we go; *viz.* As soon as the weather part of the sail catches a-back, on the tack side, the angle of incidence of the wind on it goes continually increasing, till the ship has fallen off so much, that her sail becomes perpendicular to its direction: and if the vessel continues to fall off, then the angle of incidence diminishes more and more, till the sail is parallel to the course of the wind which comes from the tack B; or, in the marine phrase, *shivering.*

CHAPTER V.

Of the masts and sails abaft the center of gravity of a ship.

39. THE main-mast and all its sails are placed abaft the center of gravity of a ship, which is also abaft the point round which the total effort of the sails is placed. They are fitted and manœuvered in the same manner as the sails on the fore-mast. There is, besides, the mizen-mast, which, when placed more aft, is highly useful in certain evolutions to accelerate, by its sails, the movements of rotation which one wishes the ship to execute. Between this last and the main-mast are placed the mizen stay-sail, and the mizen-top stay-sail, to fill up the vacancy the other sails leave between them.

ARTICLE.

ARTICLE I.

Of the effect of the Lateen sails abaft the center of gravity of a ship.

40. The center of effort of these sails being abaft the center of gravity of the ship, it follows they always force the after-part of the ship to leeward, and consequently contribute to bring her to the wind, as soon as they receive its impulse; for, that movement of the after-part of the ship cannot happen, without the head approaching to the direction of the wind.

OBSERVATIONS.

On the Lateen sails.

The Lateen sails being in general situated very obliquely, it follows, if we reason conformably to principles, that they are very advantageously so for sailing by the wind. Therefore, we must not neglect augmenting them: observing, at the same time, that they do not take the wind out of one another, nor becalm the principal sails. They are only to fill up the space between the masts fore and aft, in sailing on a bowline, in order that no wind may be lost.

ARTICLE II.

Of the effect of the sails of the main-mast, and of the mizen top-sail, in their different obliquities.

41. As we have already demonstrated (n. 19.) that when the sail A B (*fig.* 15.) is trimmed obliquely to the keel, it produces evidently two effects on the ship; we draw here this consequence; *viz.* that in dissolving its power C D, we shall find its compound effects,

effects, the one C F, in the direction of the keel which produces the velocity, and the other C E lateral, which (in forcing the after-part of the ſhip to leeward, by its action on the point C abaft the center of gravity G of the ſhip) induces her to come to the wind; for, that motion of the ſtern from C to E, cannot take place without the fore-part H acting in oppoſition by the very act of coming to the ſource of the wind W.

REMARKS.

42. If the ſails A B (*fig.* 15.) were more or leſs oblique to the keel, they would produce ſtill the ſame effects of keeping up the ſhip's velocity, and bringing her to the wind. And if they received its impulſe perpendicularly, it would ſtill be the ſame thing; with this difference, however, they would produce thoſe two effects with greater efficacy than in any other ſituation with reſpect to the wind, becauſe then they receive its greateſt poſſible impulſe for the time.

43. When the ſails A B (*fig.* 16.), of which the center of effort C is abaft the center of gravity of the ſhip, receive the impulſe of the wind W on the ſheet ſide, and obliquely placed to the keel*, they will cauſe the ſhip to fall off, by forcing the after-part of the ſhip from C to F, towards W, the ſource of the wind, while they will, at the ſame time, keep up the velocity C I. For, this motion of the after-part E towards W, cannot be executed without the fore-part H going, as it moves off, in a contrary direction; and ſhe will continue to fall off till the keel E H be right in the direction of the wind W C, or right aft; then the ſhip will come to the wind, as ſhown in the two preceding articles.

It

* Let it be well underſtood, that it is with her yards braced to port; or, to be more explicit, when a ſhip has her larboard braces hauled in aft, and the wind at the ſame time on the ſame quarter.

It may be remarked that, in this movement of the ſhip, the angle of incidence goes continually increaſing till the wind is perpendicular to the ſails.

44. When the ſails A B (*fig.* 17), of which the center of effort is abaft the center of gravity G, ſhall receive the impulſe of the wind W on their interior ſurfaces, they will make the ſhip come to the wind, and go a-ſtern at the ſame time. For, the direction of their effort C D may be diſſolved between the two efforts C F, in the direction of the keel, from forward to aft, and C E lateral and perpendicular to the keel; ſo that the after-part C H is forced to leeward from C to E, while the fore-part I approaches, by a contrary motion, the ſource of the wind W. In this caſe, conſequently, the ſhip comes to, and goes a-ſtern, at the ſame time.

REMARKS.

45. When a ſhip is ſo far come to the wind, that the fore-part I (*fig.* 17.) is poſitively in its direction, it is evident that ſhe will fall off more and more; for, the point I will be conſtantly moving from the ſource of the wind W C; therefore, it is demonſtrated that, in this caſe of evolution, the ſine of incidence is continually decreaſing more and more, till it is reduced to nothing. But, if the direction of the wind had made an obtuſe angle W C B, the ſine of incidence would have augmented until the direction of the wind had been perpendicular to the ſails; and it is at that moment only it would have begun to diminiſh, as ſhown above.

CHAPTER VI.

Of the equilibrium neceſſary to be maintained in practice, between the ſails before and abaſt the center of gravity of a ſhip, in order that the ſailing may be the moſt direct and the moſt rapid poſſible.

46. AFTER having demonſtrated the different effects of the ſails on the part of the ſhip before and abaſt the center of gravity, it is plain that, if the head, or after ſails, only were ſet, in ſailing by the wind, the ſhip would not only ſteer badly, but conſequently ſail not ſo faſt, as ſhe could under the ſame quantity of ſurface, *if an equilibrium was kept up fore and aft in the diſpoſition of the ſails.* For, if the ſhip be ſuppoſed (*fig.* 18.) to be under her head ſails, and one half be retrenched and ſet on the maſts abaſt, it will evidently appear that the velocity C T they produced is the ſame, ſince the direction and the velocity of the wind act always in the ſame manner on the ſame quantity of ſurfaces; the only difference which will be found, is, that the primitive effect is divided, and acts now on the points C, C, C, before and abaſt the center of gravity of the ſhip. But, it is not the ſame with reſpect to the effect C D, which acted to pay the veſſel's head round, in the firſt diſpoſition of the ſails, becauſe that effect being now divided on the after-maſts, it is diminiſhed one half C E forward, by the very act of its tranſporting itſelf with the ſame force aft, where, balancing the effect of falling off produced by the head-ſails, it keeps, by an equality in the movements, the ſhip to the wind (nn. 34 & 42). I ſay it balances, becauſe it is always in the power of the officer, when the

weather permits, and whenever he chooses, to increase or diminish the head or after sails, so as to maintain an equilibrium between their powers, and fix the ship on her course. No sooner is this point of equilibrium obtained, but one is sure to have got the most advantageous disposition the sails can have for the vessel to run with the greatest celerity; provided also they have been trimmed in the most favourable manner to receive (n. 28.) the greatest impulse of the wind.

THIS equilibrium between the powers of the sails forward and aft, is again infinitely advantageous with respect to the rudder; because, as there is less occasion to use it to regulate the movements of the ship, its surface opposes itself but little, as well as not so often, to the shock of the fluid, which glides along the ship's bottom. It is then of the greatest importance, when the ship sails with rapidity, to combine, as much as possible, in trying various ways, the reciprocal effect of the sails fore and aft; as for example, in setting to the wind, or in disposing more advantageously on the head or stern, a greater or less quantity of sails, according as the ship is more or less inclined to fall off, or come to; in order to be able to make as little use of the helm as possible; although, at the time of performing any evolution, its full power must be put in action; as we shall have occasion to make it appear hereafter.

OBSERVATIONS.

47. WHEN there is an equilibrium between the sails fore and aft, the resistance of the water from A to B (*fig.* 18.) on the prow is equal to the power of the sails, whether it passes through the center of gravity H of the ship, or through another point of the axis, more or less forward or aft; then a ship, thus situated, finds no more difficulty to wear than to come to the wind, with respect to the resistance of the water under her lee; since all things are equal,

equal, *viz.* the reſiſtance of the water upon the bottom to leeward, and the impulſe of the wind upon the ſails. But it muſt be conſidered that the power compoſed of thoſe of all the ſails united, acts upon the ſhip according to the direction B A, perpendicular to their ſurfaces, the origin of which is the point H, a middle between all the effects C G of the ſails placed fore and aft, which ought to correſpond exactly with the reſiſtance of the fluid from A to B: ſo that the ſhip is puſhed to leeward of the courſe I K, which ſhe holds into the direction B A of the effort of her ſails; but the reſiſtance ſhe finds from the water on the lee-ſide of her bottom, from A to B, ſets her to rights again by its oppoſition, which is greater in ratio of the greater facility ſhe finds in dividing the fluid with her ſtem, than with her ſide; ſo that ſhe runs on the true courſe N R, which approaches nearer that on which the ſhip is made to ſteer, than B A. From this may be ſeen, that the angle K H R of the lee-way is proportional to the greater or leſs reſiſtance the ſhip finds laterally from the fluid under her lee; a reſiſtance which depends intirely on the more or leſs facility ſhe finds in dividing the water with her prow; ſo that the lee-way can never be conſiderable but when cloſe hauled; a reaſon why it is not much taken notice of when the courſe is leſs oblique than the wind on the beam. This reaſoning might be carried ſtill further, from a fact undeniable in the practice by thoſe who have had any experience, and which proves that the lee-way depends, not only on the form of veſſels, but ſtill more on their greater or leſs velocity, and ſeldom, or never, on the intire diſpoſition of their ſails more or leſs oblique to the keel, as ſome authors have advanced. For, when a fine-ſailing veſſel is trimmed ſharp, with all her ſails ſet, in a very light breeze, with which ſhe hardly ſteers, the lee-way is conſiderable, though the ſea be perfectly ſmooth. The reaſon of this great lee-way, made by the ſhip, is that the veſſel being impelled gently only, and with little force, the water, which is not ſhocked with vio-

 lence,

lence, does not resist her, and she is then carried easily by her sails in the direction of their effort B A: and if we consider the side of the ship, on the act of sailing, presenting a very great surface of sails above the water, it will visibly appear the lee-way will become still more perpendicular to the keel. But, should the wind begin to freshen pretty much, then the rapidity of sailing augments considerably, and the ship shocks the fluid with a force expressed by the square of six or nine knots of velocity from B to A (*fig.* 18.) in the space of an hour, while the water repels her effort in a contrary direction: the resistance of the water is then in the ratio of this square to the square of her first velocity, and the fluid now no longer yields with facility (n. 4.); the lee-way is suddenly diminished, and is reduced to five or six degrees, and sometimes less, if the rapidity of sailing continues to increase; if, at the very time when the ship has acquired already a very great velocity, she be kept away 12° or 15°, or even 22° 30′, without altering the sails, their obliquity remaining the same, the ship should then fall off in the same proportion, according to the opinion of those who have written on the theory of the manœuvre of ships. Notwithstanding it is what never happens; the velocity augments, because the sails then receive the wind with a greater sine of incidence, and thereby acquire more power, while the prow continues to be still shocked by the fluid in the same parts, and with the same sine of incidence; so that the lee-way diminishes again, because, from the increase of velocity, the water makes a greater resistance, and that resistance is greater on the ship's side than on her prow, which is less exposed to the shock. Whence must be concluded that the lee-way, in the same ship, does not depend alone on the disposition of her sails, and that in various ships it always differs, from their not having the same form, or their sails not trimming equally in the same oblique courses; and because, in fine, none have the same velocities with the same weather, and under the same sails. Which

proves,

proves, in a word, that the lee-way is always in a proportion compounded of the velocity of the ſhip; of her form, which gives her more or leſs reſiſtance on her ſide than on the prow; and of her ſails, trimmed more or leſs obliquely.

To return to the conſideration of the action of the water on the bottom from A to B (*fig.* 18.), it muſt be remarked, that it acts afore, and that it muſt conſequently contribute very much to the facility which almoſt all ſhips have in coming to the wind, whenever the after-ſails are in the ſmalleſt degree more powerful than thoſe forward: for, in that caſe the ſhock of the water is a power which is to be added to that of the impulſe of the after-ſails, ſince this action of the fluid is ſo much the ſtronger as it acts before the center of gravity of the ſhip at the point M (*fig.* 18.), in impelling the fore part towards the wind, which always makes ſhips difficult to wear, becauſe all the effort A B of the water's reſiſtance upon the prow is oppoſed to this movement, in forcing this part to windward with a very great effort.

It is not therefore to be wondered at when ſhips wear with difficulty or ſlowly, eſpecially ſuch as have what is called a rank cut-water or long prow; becauſe there are two forces acting one againſt the other, and that the force which comes from the ſail muſt ſurmount (n. 18.) that which comes from the water, before ſhe can fall off: which will always happen with facility, whenever, in ſuppreſſing ſome of the after-ſails, thoſe forwards ſhall be diſpoſed favourably enough to produce that effect; and in uſing alſo the rudder at the ſame time, whoſe power is great, whether the ſhip goes a-head or a-ſtern rapidly.

But if the ſhip, being abandoned to her own proper movements in an oblique courſe, had on a ſudden all her ſails ſuppreſſed, it is certain the veſſel would come to the wind, ſhould even the rudder never be uſed; becauſe the water, acting on the fore part of her bottom more on one ſide than the other, impels the head to wind-

ward

ward againſt the ſmaller reſiſtance, until its power is entirely deſtroyed by the total ceſſation of the ſhip's velocity.

OBSERVATIONS.

When the ſhip runs ſo large that the after-ſails becalm part of thoſe forward, this is again another reaſon for the ſhip carrying a weather-helm, or having an inclination to come to the wind; for, the ſails forward receive a much leſs impulſe from the wind than in a courſe more oblique; becauſe the ſails abaft, by increaſing in their power, prevent thoſe forward from having as much wind as their ſurfaces require, ſince all the lee parts of theſe ſails become uſeleſs for the moment, being becalmed by the weather part of thoſe on the main maſt; ſo that the power of the ſails forward diminiſhes, while that of the after-maſts increaſes; for, the ſine of incidence is greater. The ſhip ought then, for theſe reaſons, to have more inclination to come to the wind; but, regard muſt be paid to the direction of the power of the ſails in general, which now becomes nearer the direction of the keel: ſo that the greateſt part of their effort is in that direction, while their force in the lateral one diminiſhes.

It is farther to be obſerved, that when the ſhip has as much ſail as the weather will permit her to carry, that is the moment of the greateſt velocity of ſailing, providing that the ſails having at the ſame time received the moſt favourable diſpoſition, an exact equilibrium has alſo been placed between them afore and thoſe aft, ſo that there ſhould be little occaſion for the uſe of the rudder.

APPLICATION.

48. From what precedes may be deduced the method of diſtinguiſhing the degree of quickneſs and celerity with which different

manœuvres

manœuvres ought to be performed. For example, when one is obliged to run for a road-ſtead, and to let go an anchor as ſoon as come to it, it is evident this manœuvre ought to be executed but under little ſail, which ſhould be all on the part before the center of gravity; becauſe, in the firſt place, a ſhip has always velocity enough when ſhe ſails large; ſecondly, becauſe ſhe is to overcome the effort A B (*fig.* 18.) of the water which oppoſes her movement. On the contrary, when obliged to come to the wind in anchoring, as many ſails as can conveniently be managed at that moment may be ſet, becauſe that movement of the ſhip is always very quick, and that as ſoon as the ſails take a-back, the rapidity of the ſteering diminiſhes, and in a few moments entirely ceaſes, whereas it always augments when the ſhip falls off.

ARTICLE I.

Remarks on the effect of the main-ſail.

49. In the uſe of the ſails, attention ſhould be paid to the effect of the main-ſail, which perhaps may not be that of bringing the ſhip to the wind; for, if the ſhip be too much loaded a-ſtern, the center of gravity H (*fig.* 18.) of the ſhip might very well in that caſe be abaft the main-maſt, and then the direction of the effort of that ſail, quitting the point C before the center of gravity, ought to make the ſhip fall off in lieu of keeping it up to the wind. But, that this ſhould happen, the ſhip muſt be either very ill conſtructed, or very badly loaded; or, in ſhort, there muſt have been originally a very groſs error in the firſt fixing of her maſts.

Notwithstanding the main-ſail can always, at the pleaſure of the manœuverer, be made to aſſiſt the ſhip in wearing, though the center of gravity H be (as it almoſt ever is) before the effort C of the main-ſail. To do it, the effect of that ſail need only be changed,

changed, by making it to paſs before the center of gravity of the ſhip: which will be ſuddenly the caſe, if, when cloſe hauled, the main ſheet be let go a-main, becauſe the weather part of the ſail being fixed forward by the tack, its effect is likewiſe before the center of gravity of the ſhip, though it has loſt in that part a great deal of its power, in becoming leſs expoſed to the impulſe of the wind; while the lee part, bellying out more, may receive a great impulſion of the wind, which will ſtrike it more and more perpendicularly as the ſhip ſhall fall off with more and more rapidity. In this caſe, it may happen, that if the direction of the effort C G of the main-ſail do not paſs before the center of gravity H of the ſhip, it comes ſo near that point, that it may be ſaid to have no longer the effect of an after-ſail.

ARTICLE II.

Of the rudder.

50. THE rudder is a machine known to all the marine world; it is ſupported by the ſtern-poſt, and turns on hinges thereto affixed. It acts by means of a lever, called a tiller, which enters horizontally into the ſhip, in paſſing over the tranſom; ſo that if, inſtead of leaving the rudder exactly in a right line with the keel A B, and as it were a prolongation of it, it be turned to one ſide or the other, as B D (*fig.* 19.), it receives an immediate ſhock from the water which glides along the ſhip's bottom, in running aft from A to B; and this fluid impels it towards the oppoſite ſide, while it continues in that ſituation, ſo that the ſtern, to which the rudder is confined, receives the ſame movement; and, the ſhip receiving a ſidely impulſion, her aft turns accordingly from B to *b*, on any point whatever C (n. 18.), while her head paſſes from A to *a*. It muſt be obſerved, that the water ſtrikes the rudder obliquely, and only

only with ſuch part of its motion which acts according to the ſine of incidence, in impelling it in the direction N P with a force which depends not only on the rapidity of ſailing, but alſo on the greatneſs of the angle of incidence: a force which is conſequently in the compound ratio of the ſquare of the more or leſs velocity with which the ſhip advances, and of the ſquare of the larger or ſmaller ſine of incidence which neceſſarily increaſes or diminiſhes according to the various circumſtances. So that, if the veſſel runs three or four times more ſwiftly, the abſolute ſhock of the water upon the rudder will be nine or ſixteen times ſtronger under the ſame angle of incidence, and will be augmented in a greater proportion, if the ſine of incidence be increaſed. This impulſion, or, what is the ſame, the power of the helm, is always very feeble, when it comes to be compared with the whole weight of the veſſel; but it operates with a very long arm of a lever: whence it reſults that its efforts to turn the ſhip are extremely advantageous; for, the helm is fixed at a very great diſtance from the center of gravity G, as well as from the point C, upon which the ſhip is ſuppoſed to turn horizontally, with reſpect to the point of percuſſion B: and if the direction P N of the impreſſion of the water upon the rudder be prolonged, it is evident it will paſs perpendicularly at the point R, widely diſtant from the center of gravity G; therefore the abſolute effort of the water is very powerful. It is not therefore ſurpriſing, if this machine impreſſes the ſhip with a conſiderable circular movement, by impelling the ſtern from B to *b*, and the head from A to *a*, and even much farther, when the velocity of the ſhip is kept up; becauſe the effect of the helm always keeps pace with the rapidity with which the veſſel advances.

51. AMONGST the ſeveral obliquities which may be given to the rudder, there is one ſituation which is more favourable than any of the others to make it produce with more rapidity the deſired effect of turning the ſhip, in order to change her courſe. To be

convinced of this, we have but to consider that, if the obtuse angle A B D (*fig.* 19.) were to be lessened, the impulse of the water on the rudder would augment, at the same time that it would offer a greater resistance to the sailing of the ship, since the angle of incidence would be more open, and present a greater surface (n. 7.) to the shock of the water by opposing its passage more perpendicularly. But, then the direction N P of the effort of the helm upon the ship would pass at a smaller distance from the center of gravity G towards R, and less approach the perpendicular N L, according to which it is absolutely necessary that the power applied should act with greater effect to turn the ship. Therefore, it is evident that, if the obtuse angle A B D were too much closed, the greater shock of the water could not counterbalance the loss sustained by the distance between the direction N P and that N L, or by the great obliquity which would be given to the same direction N P of the absolute effort of the helm with the keel A B.

If, on the other hand, the angle A B D were too much opened, the direction N P of the effort of the rudder would become more advantageous to turn the ship, since it would approach more the perpendicular N L, and since the prolongation of N P would augment G R, by passing at a greater distance from the center of gravity G. But, then, the rudder would receive the impulsion of the water too obliquely; for, the angle of incidence would be more acute: so that it would only present a small proportion of its breadth to the shock of the water, and of course receive also but a very faint impulsion. All which proves that the greatest distance G R from the center of gravity G, is likewise insufficient to repair the diminution of force occasioned by the too great obliquity of the shock of the water. Whence it must be concluded, that when the fluid strikes the rudder too obliquely, or too perpendicularly, a great deal of the impulsion, or of the effect it should produce, is lost. Therefore, between these two extremes, there must be a middle

middle position, which certainly is the most favourable to its operations.

52. THE diagonal N P of the rectangle I L (*fig.* 19.) represents the absolute direction of the effort of the water upon the rudder: N I expresses the portion of this effort which opposes the ship's head-way by forcing her a-stern in the direction of the keel. It is easy to perceive that this part N I of the whole power of the helm contributes little to turn the vessel; for, should you prolong I N, you might soon see that its direction passes at a very small distance G W from the center of gravity G, and that the arm of the lever B N = G W, to which the force is as it were affixed, is at most equal only to one half of the breadth of the rudder. But, it is far from being so with respect to the relative force N L, which acts perpendicular to the keel. If the first force N I is almost useless, and even pernicious, by retarding the velocity; the second N L is capable of a very great effect, since it is applied at a considerable distance from the center of gravity G of the ship, and acts on a lever's arm G E, which is very long, and necessarily very powerful. Thus, it appears clearly, that between the two effects N L and N I, which result from the absolute effort N P, there is one which is always opposing a resistance to the ship's rapid head-way, and contributes very little therefore to the motion of her turning; whilst the other alone produces that movement of evolution, without operating any way to retard her velocity.

53. GEOMETRICIANS have determined the most advantageous angle made by the helm with the line prolonged from the keel, and fixed it at 54° 44′, on a presumption that the ship is not wider at her floating line, or at the line described by the surface of the water round her bottom, than at her keel. But, as this supposition is absolutely false, inasmuch as all vessels augment their breadth from the keel upwards to the extreme breadth where the floating line, or highest water-line, is terminated; it follows that this angle

is too large by a certain number of degrees. For, the rudder is ſhocked by the water at the height of the floating line more perpendicularly than at the keel, ſince the fluid exactly follows the horizontal outlines of the bottom: ſo that one could almoſt ſay that a particular poſition of the helm might be required for each different ſine of incidence which it encounters from the keel upwards. But, as a middle poſition may be taken between all thoſe points, it is quite ſufficient to conſider the angle formed by the ſides of the ſhip and her axis, or the middle line of her length at the ſurface of the water, to be able to determine afterwards the middle point, and the middle angle of incidence.

Mr. Bouguer, in his *Théorie de la Manœuvre*, Sect. I. Liv. III., ſhows that in moſt ſhips the angle of the rudder with the prolonged line of the keel ſhould be made to be 46° 40′. Without interfering with the calculations of that author, we ſhall perhaps find means of making plain to our readers what that able geometrician has ſo learnedly diſcuſſed in a more abſtruſe manner.

54. When it is required to turn the ſhip by means of the rudder, and, at the ſame time, to preſerve the head-way as much as poſſible, it is evident that the angle 54° 44′, which has been determined to be the moſt favourable with the line of the keel prolonged, is in that caſe too open; becauſe the water acts upon the rudder with too great a ſine of incidence, and which is equal to that of the angle which it makes with the line prolonged from the keel below. Above, the ſhock of the water is almoſt perpendicular to the rudder, on account of the width of the ſhip's ſides at the floating line towards the bottom, as has been remarked before. But if the rudder oppoſes the fluid by making only with the line prolonged from the keel an angle of 45°; the impulſe, by becoming weaker, will be leſs oppoſed to the ſhip's head-way; and the direction N P (*fig.* 19.) of the abſolute effort of the water on the rudder, drawing nearer the lateral perpendicular N L, will be more advantageouſly

ously placed; since the absolute effort prolonged passes at a greater distance G R from the center of gravity G. On the other hand, experience shows us every day that ships steer very well when they do not make the angle D B E more than 35°; and if this angle be made 45°, as we require it, and then we should come to discompose the absolute effort N P, we find the side N I to be equal to the other side N L of the same square; so that the part of the power total which opposes the head-way stands in this case but on an equality with that which produces the movement of rotation; whereas, were D B E 54° 44′, N I would become much greater than N L, in proportion to the sines of the angles which are opposed to them in the triangles P I N or P L N, and the ship would of course lose much more of her velocity than in the first situation of the rudder, to which we shall confine ourselves, as being that part which suits best the generality of vessels, but which must nevertheless be sometimes altered, according as they shall be found to make an angle more or less open with their sides a-stern.

It will always be easy enough to determine the angle of the rudder with the keel, by observing the rule we have prescribed (n. 28.) in speaking of the determination of the angle of the sails.

REMARKS.

55. As the water often strikes the rudder with a very great force, one has been under the necessity to give the lever, by means of which it is put in action, a certain length, in order to diminish the effort the helmsman is obliged to make in moving it, to regulate the sallies the ship is continually making in the course of her navigation.

To lessen still more the effort of the helmsman, there is in most ships, on the quarter-deck, directly over the extremity of the tiller, a vertical wheel (*fig.* 19.), which has the effect of a capstern,

ſtern, by means of a white rope, which, after having been wound ſeveral times round the cylinder of that wheel, is ſtopped above in the middle: the two ends are then paſſed, in a fore and aft direction, athwart one another, through two longitudinal openings made on the quarter-deck, on each ſide of the barrel of the wheel, in order to repaſs on two ſheaves placed in a block perpendicularly under the aforeſaid openings. The channels of the block are placed obliquely, in order to correſpond with two other blocks fixed cloſe to the ſhip's ſide, at the points F and F (*fig.* 19.), where the end of the tiller B F touches when the rudder is in its moſt oblique ſituation. Theſe two blocks receive the rope, which thence goes to the head of the tiller, where it is faſtened. So that, if the wheel be turned either one way or the other, the extremity of the tiller approaches towards one of the ſides of the ſhip, and expoſes the rudder to the ſhock of the fluid.

56. THE longer a lever is, the more effect it has when it acts with the ſame power: therefore, the longer the ſpokes of the wheel are, in proportion to the radius of the cylinder round which the rope is wound up, the more advantage the helmſman will have; for, if the ſpokes of the wheel be three or four times longer than the radius of the cylinder, the helmſman will act with three or four times more force, ſince he acts on a lever which is three or four times longer than the radius of the cylinder the extremity of which is ſuppoſed to be the fulcrum of the lever on which he acts. So that, if the effort of the helmſman be equal to 30 pounds weight, he will produce an effect of 90 or 120 pounds by the mere diſpoſition of the wheel only. On the other hand, the impulſe of the water is united in the middle of the breadth of the rudder, which is very narrow, if compared to the length of the tiller; therefore, the effort of the water is at a very trifling diſtance from the point of ſupport B upon which it turns: whereas the tiller forms the arm of a lever 10 or 15 times longer, which ſtill increaſes the power

power of the helmſman in the ſame proportion as is between the length of the tiller and that of the lever on which the impulſe of the water acts. This force is therefore 10 or 15 times ſtronger; and the effort of 30 pounds, which before gave the helmſman a power of 90 or 120 pounds, will become one of 900 or 1800 pounds on the rudder. The cauſe of this advantage is, that the ſhock of the water acts on a very ſhort arm of a lever, while the ſteerſman acts on one very powerful in compariſon to the other; and, that this lever is moved by a wheel which ſtill multiplies its force. This demonſtration ought to remove the very great ſurpriſe ſome perſons expreſs at the prodigious effect of the rudder, when they do not pay attention to its mechaniſm; for, they have only to conſider the preſſure of the water, which acts at a very great diſtance from the center of gravity G of the ſhip, as well as from the point C upon which it is ſuppoſed ſhe turns (n. 15.); and they will ſoon eaſily perceive the difference there is between the effort of the water againſt the helmſman, and the effect of that ſame impulſion againſt the ſhip: for, with reſpect to the helmſman, the water acts with the arm of a lever N B very ſhort, of which B is the point of ſupport or fulcrum. On the contrary, with reſpect to the ſhip, the impulſe of the water acts on a direction N P, which paſſes perpendicularly at a very great diſtance from the center of gravity G, in acting on a very long lever E G, which renders the action of the rudder very powerful in turning the ſhip; ſo that, if, in a large ſhip, the rudder receives an impulſe from the water of 2700 or 2800 pounds (as is very often the caſe, provided that the ſhip ſail at the rate of 9 or 12 knots, and that this power, applied at E, be 100 or 110 feet from the center of gravity G), it will act upon the ſhip to turn her with a power equal to 270,000 or 308,000 pounds, while, in this laſt caſe, the helmſman may very well act with no greater a power than one of 30 pounds only, on the ſpokes of his wheel.

57. It

57. It may not be improper to remark here, that the great length generally given to the tiller, in order to facilitate the operations of the helmſman, is an obſtacle to the play of the rudder; ſince that length hinders its preſenting itſelf ſufficiently to the ſhock of the water to produce all the effect which may be expected from it. For, this inconvenience does not, in moſt ſhips, allow the rudder to make the angle D B E (*fig.* 19.) more open than 30°; whereas it ſhould be 45°, as has been made appear before.

But, as this moſt favourable determination has not yet been made uſe of, but the coarſe dimenſions commonly given the tiller have always been followed, we think ourſelves under an obligation to correct that error, and to propoſe ſomething better for practice.

It muſt be conſidered, that if the tiller was ſhorter, the rudder would have more play, becauſe the extremity of that lever, in deſcribing the arc of a ſmaller circle, would occaſion the rudder to make an angle more open, with the keel prolonged: and this new augmentation would be ſo much the more advantageous, as it would come nearer the angle of 45°, which we have adopted for the beſt. And as in all ſhips the length of the tiller might certainly be cut a fifth ſhorter, or perhaps more, it is evident that, by ſuch means, the angle of the rudder and the keel prolonged might be rendered very near 45°, which would increaſe its force in a proportion as 3 is to 5, ſince the ſquare of the ſine of incidence of 45° is to the ſquare of the ſine of incidence of 30° : : 5 : 3, or thereabouts.

This augmentation of the impulſe is often of the greateſt importance, eſpecially in the full evolutions one has ſometimes occaſion to make ſhips go through, and above all when they are of a large ſize, as their motions are but ſlow on account of their length.

If the tiller be ſhortened, the helmſman will be obliged to employ more force in proportion to the length taken from the lever on which he now acts; but this loſs may be repaired by the facility with which the helm ſhall be handled, if the diameter of the

cylinder

cylinder of the wheel be a great deal leſſened, at the ſame time augmenting the length of its axis without diminiſhing that of its ſpokes, which ought on the contrary to be lengthened as much as poſſible, and let two turns more of the tiller rope be wound round the barrel.

THESE forces would be ſtill much more multiplied, if two ſheaves were fixed in the end of the tiller, in two mortices which might be made for that purpoſe, with an iron pin paſſing through their centers, and taking care to have the end of the tiller well hooped with iron, in order to ſtrengthen it; then the tiller rope might be reeved through the blocks which are for that purpoſe on each ſide the ſhip, and thence through the two ſheaves at the end of the tiller, and the ſtanding part to be affixed cloſe to the blocks on each ſide of the ſtarboard and larboard. By theſe means nothing would be loſt with reſpect to the force; becauſe, if the lever be ſhorter, the forces which cauſe its action are likewiſe multiplied in proportion.

58. AFTER what has been ſaid reſpecting the helm, it is eaſy to conceive that the greater the ſhip's velocity is, the more powerful is the action of the rudder, ſince it acts againſt the water with a force which increaſes as the ſquare of the velocity of the fluid (n. 3.), whether the ſhip has head-way, or ſtern-way; always recollecting, that in theſe two circumſtances its effects are oppoſite; for, if the ſhip goes a-ſtern, the rudder will be ſtruck from I to N (*fig*. 19.); and inſtead of being puſhed from N to P, it will be ſo from N to R; ſo that the ſtern moving in the ſame direction, the prow of courſe muſt take a contrary one, and move towards the ſame ſide that the tiller B F is on*.

59. IT

* It may be objected to this new mode of increaſing the purchaſe of the helmſman, here propoſed by Mr. BOURDE', that it will prolong the motions of the rudder: I grant

59. It ought to be obſerved, in the uſe of the rudder, that there is one part of its effort which is hurtful to the ſhip's ſailing when it is ſtruck by the water which runs rapidly along the ſhip's bottom. If it makes an angle of 45° with the keel prolonged, then it receives only half the impulſion it would if the fluid acted upon it perpendicularly; becauſe there are two cauſes for the abſolute impulſe diminiſhing (n. 7.): firſt, The ſurface which oppoſes the ſhock of the water is reduced to a leſs extent than it was at firſt, and the angle of incidence diminiſhes likewiſe: ſo that, in this caſe, the impulſe has diminiſhed one half. The next cauſe to be conſidered is that ſame impulſion N P which remains (*fig.* 19.); for, it will appear then that there is only one part N I which is oppoſed to the ſailing (n. 54), and which is leſs than N P in the proportion as the ſine total is to the ſine of 45°, the meaſure of the angle of incidence W N B equal to N P I; for the angle W N L is right, as well as the angle P N B; ſo that, if you take away the common angle L N B, the two angles P N L and W N B will remain equal between themſelves; but, as the angle I P N is equal to its alternate angle P N L, it follows that I P N is always equal to W N B, whether the angle made by the rudder be more or leſs open with the keel prolonged. So that, if the ſurface of the rudder which receives the ſhock be 80 feet ſquare ſuperficies, it will firſt be reduced, by the manner in which it is expoſed to the courſe of the fluid, to an effort of 40 feet ſurface, then to 28 or 29, becauſe, in the firſt place, there is but one part of the velocity of the water which

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I grant it will to a certain point; but, when the diſparity of the arcs deſcribed by the tiller are conſidered, the difference will be found but trifling, and cannot (I imagine) come in competition with the many great and good effects which muſt neceſſarily attend the increaſe of the angle of the rudder with the keel prolonged.

which contributes to the ſhock, and that part is proportional to the relation between the ſquare of the ſine total and that of the ſine of incidence; and, ſecondly, becauſe out of the abſolute impulſe N P, which reſults from this laſt oblique ſhock, there is only a part N I which oppoſes the velocity of the ſhip proportional to the abſolute N P, in the ſame ratio as there is between the ſine total and the ſine of incidence; that is to ſay, that when the rudder makes, in the largeſt ſhips, an angle of 45°, it impedes the ſhip's rapidity of ſailing, in the direction of the keel, with an effort N I equivalent to the impulſion which a ſurface of 28 or 29 feet ſquare might receive, if it was expoſed perpendicularly to the ſhock of the water. So that, if the ſhip runs 12 knots an hour, or 19 feet a ſecond, the effort of the rudder N I, which oppoſes the rapidity of the ſailing, will be 12,499 or 12,945 pounds, as ſalt water weighs $\frac{1}{33}$ more than freſh.

OBSERVATIONS.

60. IT follows, from what has been ſaid of the rudder, that it ought to be uſed as little as poſſible; that is to ſay, the ſhip and and her ſails ought to be ſo diſpoſed, that the ſmalleſt motion of this machine may bring her to her courſe, if ſhe deviates from it, or make her perform any evolution which may be thought requiſite.

ARTICLE III.

The time employed by different veſſels to perform the ſame evolution, is as their length.

61. ALL that tends to produce motion in ſhips, has more force in the larger than in the ſmaller ones; but the difficulty which

large ſhips experience to receive the motion is greater, in a greater proportion, than that which oppoſes the motion of ſmall ſhips. For, if the dimenſions and machines which enter into the compoſition of a large veſſel, have twice the magnitude of thoſe which conſtitute a ſmall one, ſolidities being in ratio of their cubes, the firſt will be eight times as great. Yet the obſtacle which the large ſhip will oppoſe to its being put in motion will be two and thirty times as great as that of the ſmall one. For, if both ſhips were conſidered as divided into an equal number of vertical ſections, thoſe of the large would ſoon appear to have four times as much ſurface as thoſe of the ſmall, beſides that they would be twice as thick, ſince the dimenſions are in general twice as large; conſequently they will have eight times the ſolidity; which anſwers already to the relative effort of the rudder and ſails.

AGAIN, the parts of the large ſhip are twice as diſtant from the center of gravity as thoſe of the ſmall one, ſince thoſe diſtances are proportional to the other ſimple dimenſions of the two ſhips. So that, if the evolution be ſuppoſed of the ſame number of degrees, the extremities aft and forward of the large ſhip will have to deſcribe arcs twice as large as the ſmall one; and this greater velocity being multiplied by the ſolidity of the parts of the large ſhip, which is eight times as great as that of the ſmall one, the product will give 16 times more motion; the reſiſtance, or *vis inertiæ* *, will act conſequently 16 times as much on the large as on the ſmall; and as that reſiſtance operates on the arm of a lever twice as long,

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* *Vis inertiæ*—Is a force which reſides in bodies at reſt, or in motion. It is that force, which cauſes them to reſiſt motion when at reſt, and oppoſes being ſtopped when put in motion. The firſt we experience every day when any thing is moved; and the ſecond will manifeſt itſelf if an attempt be made to ſtop ſuddenly a body in motion. TRANSL.

long, the momentum* or total reſiſtance of the large ſhip will be 32 times as great. Therefore, ſhould the forces which act on the large ſhip be augmented no more than in proportion to her ſolidity, ſhe will have ſtill four times more difficulty than the ſmall one to get into motion. Therefore the large ſhip, inſtead of making in the ſame ſpace of time an angle of rotation as great as the ſmall one, will only make an angle of one fourth, or, in other words, three times leſs. Now, that the great ſhip ſhould deſcribe an angle of rotation equal to the other veſſel, it will require only thrice as much time: but that angle, or the velocity with which the ſhip obeys the impulſe of her rudder and ſails, will follow the laws of acceleration, ſince the velocity acquired in the firſt inſtant is continually augmenting in an arithmetical progreſſion; ſo that the time which ſimilar veſſels of different ſizes take in performing the ſame evolution, will be in proportion to their lengths.

The heavier a body is, the greater is the effort neceſſary to put it in motion: *vice-verſâ,* the more difficulty there is found in putting a heavy body in motion, on account of its volume three times as heavy as that of a ſmaller one compared to it, the more difficulty, of courſe, will be found alſo in the heavieſt body to make it loſe the velocity of that movement once impreſſed on it, comparatively ſpeaking, with the difficulty found in performing the ſame operation on a ſmaller body. For, this having been put in motion with three times the facility, will be ſtopped with the ſame eaſe. The reſiſtance

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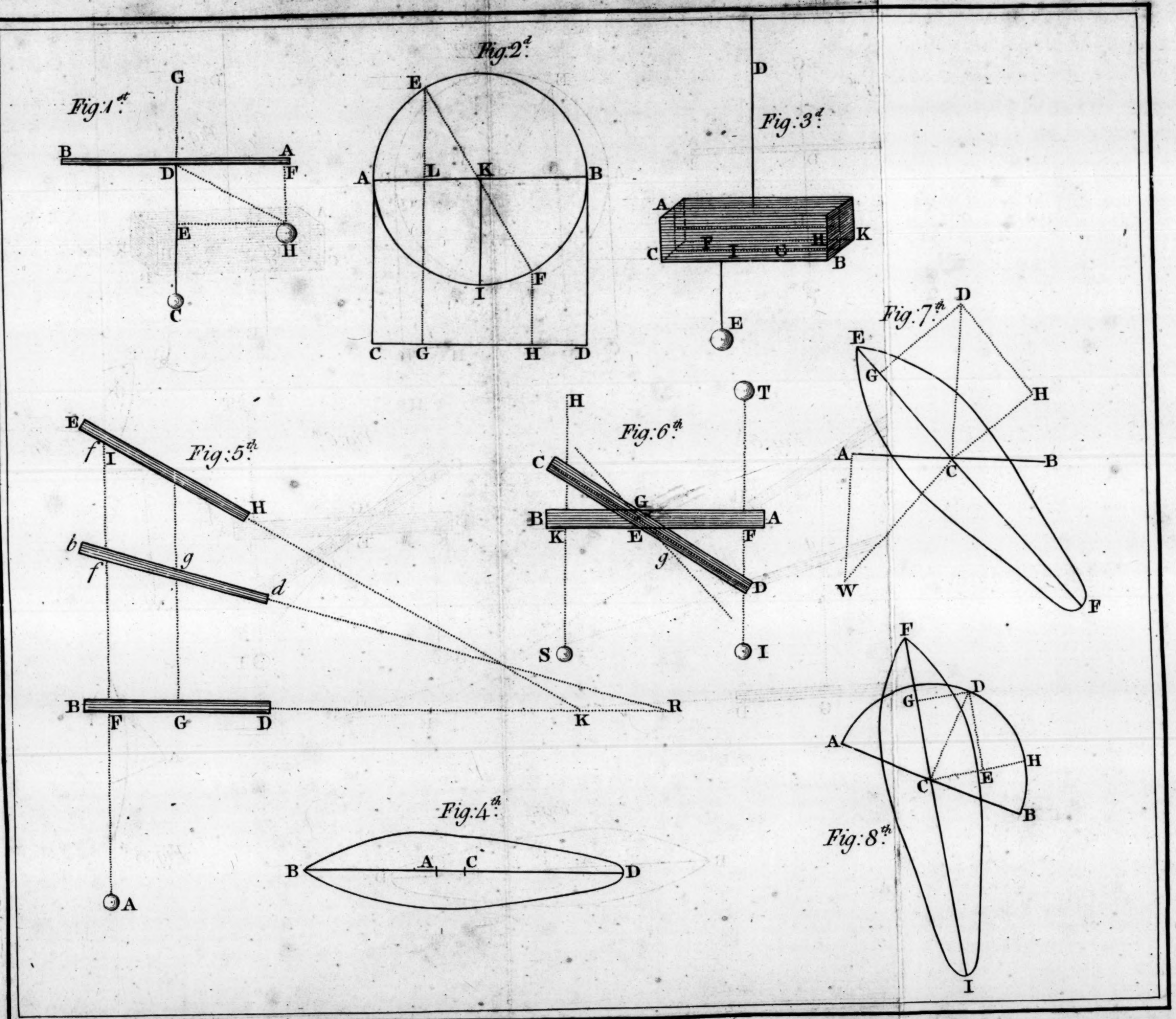
* *Momentum*, in mechanics, is the produce of the maſs of any body whatever by the diſtance of its center of gravity, from a point taken at pleaſure. The *momentum* of a body which falls, is the product of its maſs, by the velocity acquired in the firſt inſtant of the ſhock. The *momentum* of a force, which acts on the arm of a lever, is the product of that force by the diſtance from the fulcrum or point of ſupport. TRANSL.

resiſtance a body oppoſes to loſe a movement is always equal to that employed by the ſame to acquire it. So that, if a veſſel 100 feet long takes four minutes to perform an evolution, a ſimilar veſſel of 150 feet will take ſix minutes or thereabouts to perform the ſame circular movement. 100 : 150 :: 4 : 6. *Q. E. D.*

END OF THE FIRST PART.

AN



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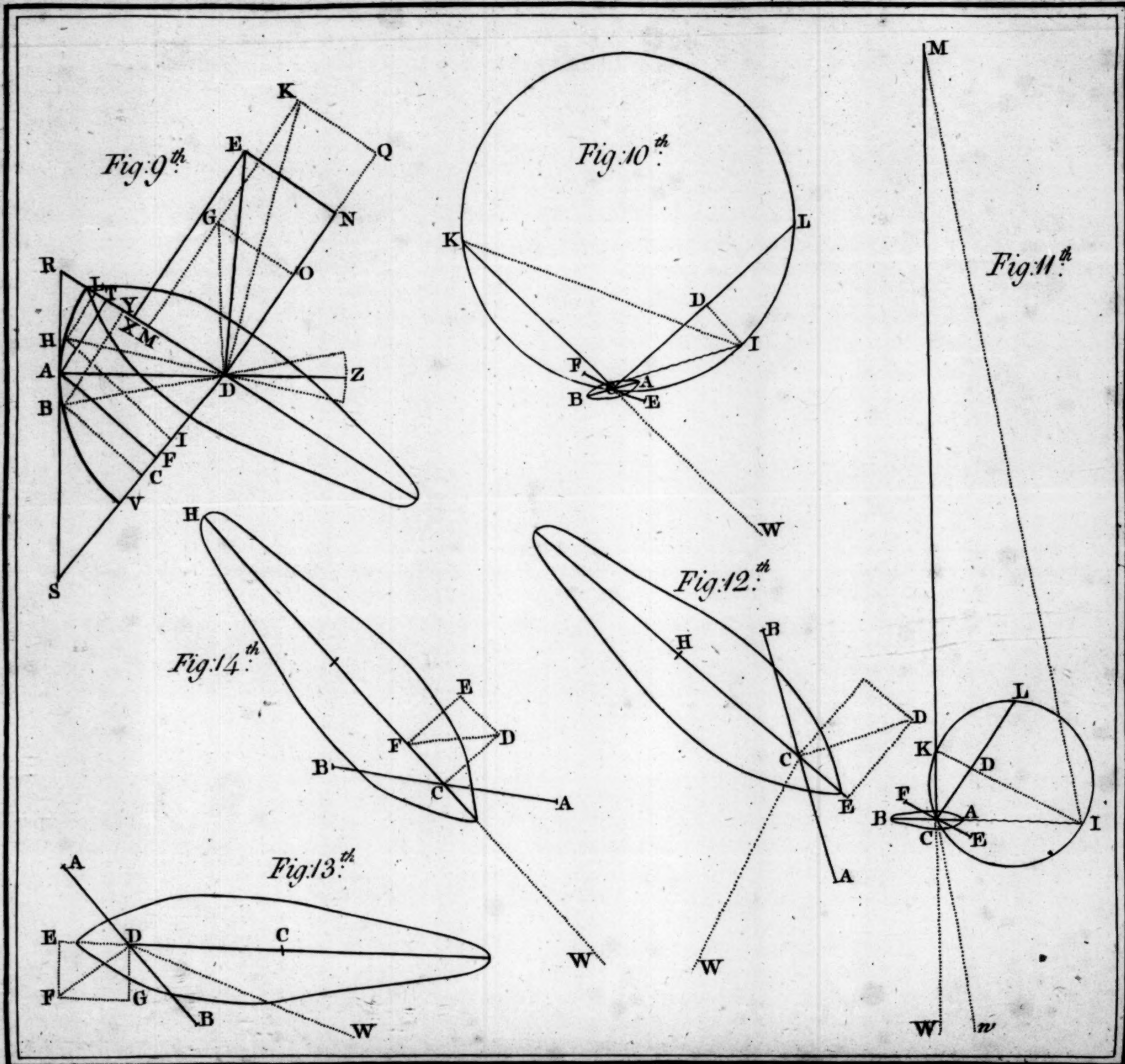
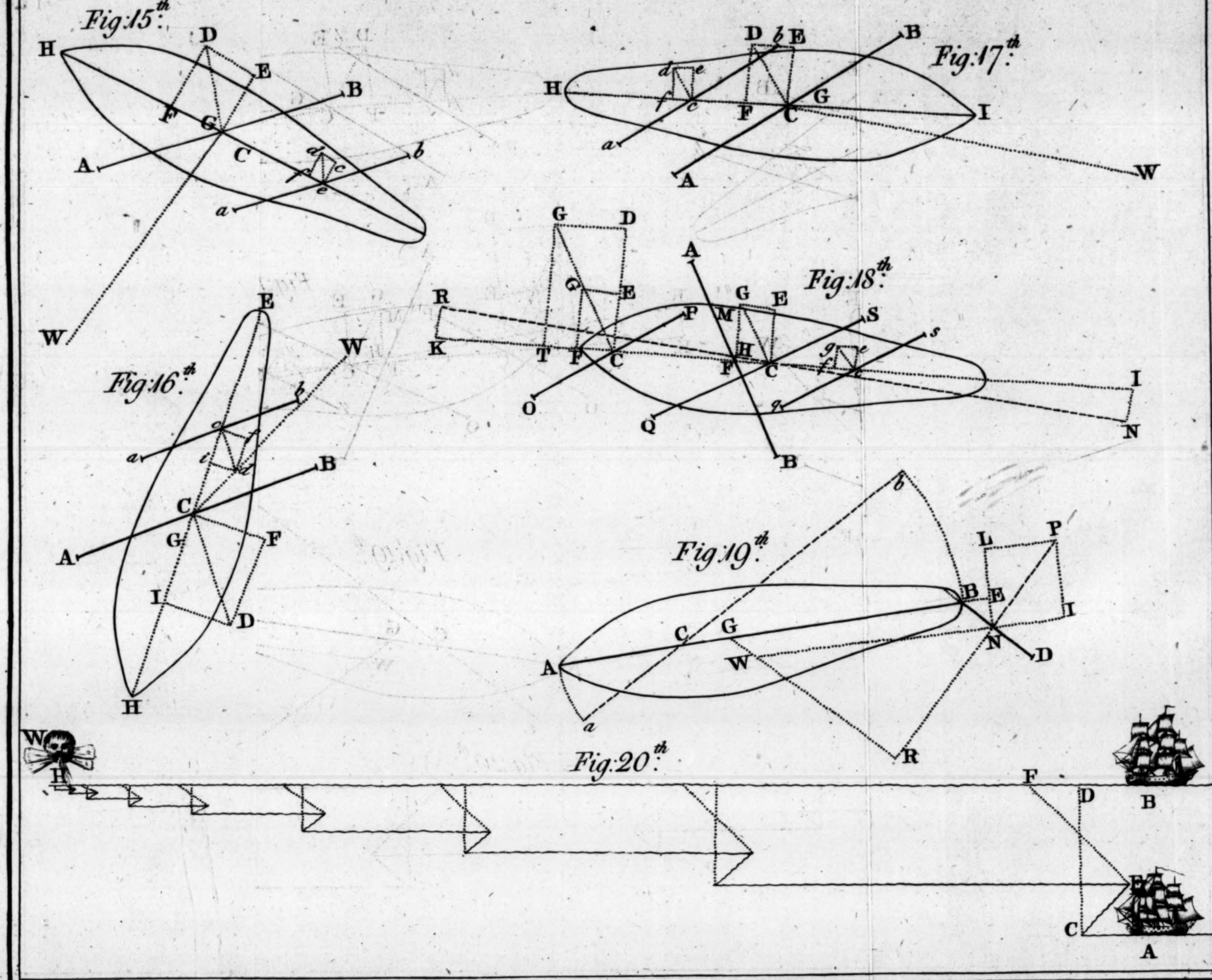
NAVAL TACTICS, Pl.II.





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AN

ESSAY

ON

NAVAL TACTICS.

PART THE SECOND.

The Theory applied to Practice; or, a Demonstration of the Evolutions of a Ship.

WE are now entering into the most brilliant part of the Seaman's duty, which requires him to be continually in action, and always availing himself of the theoretical knowledge he possesses, in order to apply it with judgement to practice: which will enable him to dispose of the machinery which composes and guides the ship with such skill as to place her with the greatest expedition in any required position.

CHAPTER

CHAPTER I.

Of getting under sail.

ARTICLE I.

PROBLEM I.

To get under ſail when the ſhip is ſwinging head to wind, and you want to caſt to ſtarboard in a place where there is no current.

SOLUTION.

YOU muſt heave ſhort on your anchor till it is a-peek: then haul in quite home the larboard braces forward, and ſtarboard braces abaft: looſen, ſheet-home, and hoiſt the top-ſails, ſhould they not be ſo already: put the helm a-ſtarboard, and heave round till the anchor is a-weigh. The moment the anchor quits the ground, the ſhip will begin to fall off to ſtarboard; a movement which you no ſooner perceive her to make, but you muſt help her by ſetting the jib and fore-top-maſt ſtay-ſail: and when ſhe has ſufficiently fallen off, her ſails abaft (which are trimmed ſharp for the larboard tack) will fill. But, unleſs it is for very ſuperior reaſons, you had better to continue lying-to till the anchor is catted, taking care however to haul the mizen-ſheets cloſe aft, if the ſhip be inclined to fall off too much.

DEMONSTRATION.

DEMONSTRATION.

You heave ſhort before the top-ſails are looſened, in order to facilitate the manœuvre of the capſtern, which would act with too much power, if they were ſet; ſince they would be a-back, and conſequently in a ſituation to ſend the ſhip a-ſtern; whereas ſhe ſhould go a-head when you are heaving on your cable. The larboard braces are hauled in forward, becauſe, in that ſituation, the ſails are ſo braced as to caſt the ſhip's head to ſtarboard, ſince they make with the keel the moſt acute angle poſſible a-ſtarboard forward, and are at the ſame time a-back. Beſides, the after-ſails being braced up to ſtarboard and ſharp trimmed, are alſo taken a-back like the others, and receive the wind in ſuch a manner as to turn the after-part to port. Therefore, there are always two powers acting in contrary directions, one before and the other abaft the center of gravity of the ſhip; the one forces the fore-part to ſtarboard, and the other impels the after-part to larboard.

As theſe two effects cannot happen without the ſhip going a-ſtern the moment the anchor quits the ground, ſince ſhe is no longer with-held by any thing, and is moved by an exterior fluid power which carries her in this direction, part of the effect of her ſails giving her ſtern-way (n. 21.); it follows, that the helm muſt be put to ſtarboard, that the rudder may help her after-part round to larboard (n. 58). By theſe means every thing is diſpoſed to make the ſhip fall off to ſtarboard; which is the ſolution of the whole problem; recollecting however that what we call the jib and fore-top-maſt ſtay-ſail are not added to the evolution, unleſs there be reaſons to fear the ſhip will not fall off faſt enough; and when you find ſhe has ſufficiently done ſo, the mizen is to be hauled out, to procure the contrary effect, and thereby to counterbalance the jib and ſtay ſail, which it is very often neceſſary to keep ſet.

REMARKS.

If there was an abſolute neceſſity to caſt to port, you ſhould then haul-in the ſtarboard braces forward, and the larboard braces aft, and put the helm a-port; the reſt of the manœuvre is the ſame as in the preceding caſe, and could be proved by the ſame reaſoning; only changing, in the demonſtration, ſtarboard for port, or larboard.

If a ſhip, riding head to wind and tide, wanted to get under ſail; after having decided which ſide it is beſt to have her caſt, you muſt manœuver according to one of the foregoing methods, except the helm, which muſt be put to ſtarboard, either before the anchor looſens, or while it does, if you wiſh to caſt to port; becauſe the water, coming from forward, acts with the ſame force on the rudder as if the ſhip went along with the current, and impels the rudder to ſtarboard, and the head to port. Therefore, it is evident, in this caſe, the helm ought to be put to ſtarboard; which, on the contrary, would be put to larboard, was the ſhip to be caſt to port.

If the ſhip, after the anchor is out of the ground, went a-ſtern faſter than the current runs, the helm muſt then be uſed as if there was no current, becauſe the exceſs of velocity, whereby the ſhip exceeds that of the water, acts upon the rudder.

If it blows freſh, ſo that you cannot ſet your top-ſails without reefing them, let that be done before they are ſheeted home; and if it blew ſo hard as to compel you to ſail onward with only your fore-ſail, it would be then ſufficient to looſen the fore-top-ſail, without tallying it, after having braced it quite cloſe on the ſide oppoſite to that you want the ſhip to caſt, not forgetting however to put the helm the ſame way as you caſt, as ſoon as you perceive the ſhip going a-ſtern; and when the ſhip has fallen off ſufficiently, then is the time to fill and trim the fore-ſail.

ARTICLE

ARTICLE II.

PROBLEM II.

To get under ſail when the ſhip is ſwinging with her head to the current, and with the wind a-point abaſt the beam.

SOLUTION.

THE top-ſails being furled with rope-yarns, let them and the mizen top-ſail be hoiſted, and properly trimmed, as if they were ſet; and when every thing is properly diſpoſed, heave ſhort on your anchor till it is a-peek; next to this, looſen, tally the fore-ſail and mizen top-ſail, keeping the wind in, and heave quick and vigorouſly the capſtern till the anchor is a-weigh. At the ſame time hoiſt the jib and fore-top-maſt ſtay-ſail, or haul out the mizen, according as circumſtances may require. Whether you wiſh to come to windward, or fall off more quickly, you muſt ſtill continue to heave round the capſtern briſkly to get the anchor up, till you find yourſelf ſufficiently offward to bring to, in order to ſtow it with eaſe, or to ſtand on under an eaſy ſail with the anchor hanging out to windward, if the ſituation of things will admit of it. You may ſometimes alſo hoiſt up both the main and the fore top-ſails, as ſoon as you get ready; but, in certain caſes, when obliged to make the beſt of your way and ſail at the higheſt rate, every ſail poſſible muſt be ſet at once which the weather will admit of; eſpecially when obliged to haul by the wind; in which caſe, the anchor muſt be got up and catted as well as it can: there are caſes even when, without loſing your time in weighing it, you crowd as many ſails as you poſſibly can, and depart in cutting the cable, or veering it end for end.

DEMONSTRATION.

The top-ſails and the mizen top-ſail are hoiſted up, becauſe the ſails in that ſituation are eaſier ſheeted home and trimmed; and becauſe, as ſoon as the rope-yarns are cut, the ſails fill, and give celerity to the ſhip, which ſails onward the moment the anchor quits the ground. The mizen top-ſail is uſed to make the ſhip ſteer well, as one has it in one's power to keep it either filled or looſe to the wind, according as the ſhip is griping or the contrary; beſides the aſſiſtance of the rudder, which is to be employed as ſoon as the ſhip begins to move.

REMARKS.

It happens ſometimes, in getting under ſail, that you are obliged to heave the anchor up to leeward; which often gives a dangerous ſtrain to the capſtern; becauſe the ſhip, driving to leeward as ſoon as the anchor is a-weigh, cauſes the cable to gird againſt the lee bow, and the ſtock of the anchor is very apt to catch the cut-water. To avoid this embarraſſment, let the ſhip (if you are near the land) get offing enough to wear and bring the anchor on the weather bow.

I was once in ſuch a ſituation as is here mentioned, and was obliged to perform this manœuvre, which is not difficult to conceive; becauſe the ſhip, lying to leeward of the anchor, or ſtanding on under an eaſy ſail, drifts, and conſequently leaves the anchor diſengaged to windward; which enables us to heave it up with facility.

ARTICLE

ARTICLE III.

PROBLEM III.

To get under sail with a spring.

SOLUTION.

If a ship be in a place too much confined to cast under her sails only, or if one is obliged to put to sea in a gale of wind, without lifting the anchors; you must, for greater safety, and in order to facilitate the falling off, cast a spring out, to be clapped on the cable by which the ship swings, by getting a hawser or a stream-cable to pass through the aftermost port, on the opposite side to that you mean to cast; and, after that spring is well heaved taught at the capstern, hoist the jib and fore-top-mast stay-sails, loose, and sheet home the fore-top-sail; then, when that is done, and if the weather permits, brace quite close the head sails on the same side with the spring: and, when this is executed, slip or cut the cable, heaving briskly at the same time on the spring, till the ship has paid off sufficiently. Then, when you find she has enough, you fill the sails, in setting the mizen-top-sail and every other sail you mean to employ, and slipping the spring if you have time enough, for if you have not you must cut it off instantly. Care must be taken, in performing this manœuvre, not to let the ship fall off too much before the spring is cut; because, having no way through the water, she cannot be brought to the wind so soon as might be wished; *which may be productive of bad consequences in a narrow place:* and, for the same reason, the spring must not be cut, till the ship has fallen off as much as is necessary; because, although she has no other motion but that of falling off, the vessel might perhaps not wear enough to answer the purpose.

DEMONSTRATION.

DEMONSTRATION.

The reaſons having been ſhewn before why the head ſails are braced up on the oppoſite ſide to that which the ſhip caſts, they ſhall not be repeated here; although we ſuppoſe the wind ſo ſtrong as to keep the ſhip wind-ridden. I ſhall only undertake to prove, that the ſhip turns almoſt on the middle of her length; ſince the moment the fore part begins its movement of falling off on one ſide, the after part makes another to approach the point from which the head is receding. Now, ſhe turns ſo much the more ſurely on her center, and her evolution is ſo much the more rapid, as the force uſed in heaving at the capſtern is ſtronger: becauſe the more powerful the heaving is, the more of the hauſer comes in, and conſequently the more eaſily and with the greateſt rapidity will the after part approach the point the head of the ſhip has left.

When ſhe has fallen *off* enough *to fill the ſails properly*, ſlip the ſpring, becauſe ſhe gathers head-way in proportion as the ſails are filling, and in that caſe the hawſer would only hinder the ſhip going a-head, or cauſe her to fall off more, which would be prejudicial to the evolution. The hawſer or ſtream cable is paſſed aſt as far as poſſible; becauſe, being at the extremity of the ſhip, the capſtern ſtrains leſs, and the veſſel turns with more celerity.

OBSERVATIONS.

If this manœuvre is performed when it blows hard, you muſt not ſheet home the fore-top-ſail: for, if the wind is abſolutely too ſtrong, you muſt content yourſelf with only looſening this ſail, and hoiſting the fore-top-ſtay-ſail: but, if the weather is pretty tolerable, it will be found ſufficient to ſheet home the fore-top-ſail without hoiſting it.

ARTICLE IV.

General remarks on getting under ſail.

WHENEVER a ſhip is going to ſail onward, ſhe muſt, before her ſails are ſet up, and as ſoon as the anchor begins to quit the ground, have her top-ſails at the maſt-head ſtopped with rope-yarns. And indeed any veſſel which is proud of manœuvering with propriety and velocity, ought to obſerve this precaution when the weather will permit, no matter in what latitude ſhe may be. Such manœuvre is general, when the wind is not too powerful.

WHEN the tide takes the ſhip on the beam, and ſhe is to caſt the other way, it is evident that the tiller in the firſt inſtant muſt be put on the ſide the current runs from, becauſe the rudder will be in ſuch a ſituation as to receive very obliquely the impulſe of the fluid, and conſequently will but little oppoſe the ſhip's falling off, provided the ſhip's velocity does not exceed that of the current.

WHEN in a ſituation where caſting is indifferent, one way or the other, always let it be to leeward of the anchor, that there may be no riſk of its getting foul of the cut-water.

CHAPTER II.

PROBLEM.

To tack a ſhip, in getting to windward as much as poſſible.

SOLUTION.

TO execute this manœuvre with propriety, care muſt be taken that the ſhip does not yaw, that ſhe is not too much from, or near, the wind; becauſe both ſituations are equally prejudicial to the

the evolution: and when that precise point is attained, which is not very difficult, haul the mizen out, if it be brailed up, *(the power of which is carefully to be preserved*)*, while you put at the same time the helm a-lee, and brace the bow-line quite to leeward, that the mizen may be as much as possible exposed to the wind: and, when the ship is come to the wind, so as to cause the square sails to shiver, let go the jib and all the stay-sail sheets before the main-mast: then, the moment all the sails catch *a-back*, and particularly the mizen top-sail, let it be braced sharp about the other way; hauling up, at the same time, the weather clue of the main sail; and immediately (the wind being right a-head, or even a little before) fill up the main-top-mast's sails: and trim sharp for the other tack as fast as possible.

THE jib and stay-sail sheets are also to be shifted over at the same time, in righting the helm, whether the ship has lost her way, or even still advances a-head. Then, as soon as she has passed the direction of the wind 45°, in continuing her evolution, shift the fore-mast's sails, which are to be trimmed with all the same celerity in putting the helm a-lee, if you fear the ship (which must still go a-stern if the manœuvre be slowly executed) will not fall off sufficiently: for, if the sails are braced about briskly, she will never have stern-way; on the contrary, she will get a great deal to windward. Thus, every thing before directed being exactly executed, and the sails well trimmed on the opposite tack, the problem is solved.

DEMONSTRATION.

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* For, the mizen operates as it were another rudder, by the action of the current of air upon its surface, and ought consequently to have its impulse preserved as much and as long as possible. Moreover, it acts on a very long and necessarily very powerful arm of a lever to turn the ship. True it is, that part of its effect tends to lessen the celerity of sailing; but, is not the helm in the same predicament, and in a proportion to the magnitude of their surfaces, and of the densities of the fluids to which they are exposed? TRANSL.

DEMONSTRATION.

I SAID, and it remains now for me to prove, that it is prejudicial to the evolution, to be too near to, or too much from, the wind, previous to tacking a ſhip. In the firſt place, if too near the wind, when the helm is put a-lee, ſhe will probably miſs ſtays; ſince the ſhip, not having a ſufficient velocity, the rudder will not have all its neceſſary effect to cauſe the ſhip to double upon the critical point where all the ſails ſhiver. For, the power of the rudder to turn the ſhip, is proportional to the force with which the water ſtrikes it (n. 58). Hence it follows, if the ſhip has not ſufficient way through the water, the rudder will not have force enough to cauſe her to force over the point, or any thing elſe which can increaſe or keep up the rapidity of ſteering; and, of courſe, the power of the helm will ceaſe, the ſails being all ſhivering. The ſhip muſt then unavoidably fall off again, ſince the helm is a-lee, and not one of her ſails tends to ſhoot her a-head. On the contrary, her mizen-ſail being out, and braced quite to leeward, forces the ſtern and the ſhip athwart (n. 40.); while, by the wind which ſtrikes her ſails, rigging, and hull, ſhe is but too ready to drive a-ſtern; as a ſhip always finds great difficulty to divide the fluid laterally. Thus it is clear that, every thing being diſpoſed for driving the ſhip the ſtern-way, ſhe muſt infallibly both go a-ſtern and lee-ward (n. 58). This is confirmed by experience; for, whenever a ſhip miſſes ſtays, ſhe is viſibly perceived to fall abaft.

IF a ſhip is too much away, ſhe is much longer in ranging to the wind. Conſequently, lee-lurches, previous to tacking, are diſadvantageous and uſeleſs to the evolution, ſince they retard it.

I SHOULD not have mentioned this cuſtom, had I not ſeen many ſeamen, through mere habit, put it in practice, and fail, by this

movement, in their evolution; which would however have succeeded, had they not had the habit of letting go the fore-jib, and stay-sail sheets. When, as I said before, these have been kept fast, the edging away can only prolong the time of the evolution; but, if the fore, jib, and stay sail sheets be let go, as a great many do at every turn (and as in some particular cases it is really found necessary), care must be taken by such officers, not to suffer the ship to fall off too much: because the velocity of the ship not being sufficiently kept up (n. 46.), when the ship comes to the wind, it follows that she has lost a good deal of it, before she is come to the critical part of the evolution, where all the sails shake or shiver. So that, when the ship is at that point, the velocity is so much diminished, that the rudder has not power enough to cause her to double it: on the other hand, the fore part of the ship is no longer carried to the wind with the same force, since the vessel no longer shocks the fluid (n. 47.) with her first velocity.

THE mizen is hauled out to help the rudder; because these two forces act together in impelling the after part of the ship to leeward (nn. 40. & 50.), when the helm is a-lee, and the ship of course head to wind; which after part continues that circular motion, first by the effect of the rudder, till the head-way ceases; and then by that of the mizen, till the other sails take the wind from it. Therefore, when the mizen is becalmed by the other sails, the evolution is sure, as this could not happen if those sails were not taken a-back.

YOU must wait till the square sails begin to shiver, before letting go the jib and all the stay sail sheets, which are before the main-mast; because, till that moment, these sails concur to maintain an equilibrium with the others, and keep up the ship's velocity; since it is the disposition of the different sails set on the different parts of the ship, which gives her more or less way through the water (n. 46.), and because then they are the only ones which tend to

make

make the ſhip fall off (n. 31.), ſince they are the only ſails fit to be filled, the others being ſhivering. It is then abſolutely neceſſary at this moment to ſuppreſs their effect, ſince it is contrary to the movement of the ſhip, ſhe being to turn now with nothing but with the ſole effect of the rudder and the mizen, as her velocity has been maintained till this inſtant by all the ſails together, and which ſails ought, by all that has been ſaid, to ceaſe acting all at the ſame time, the mizen excepted, the action of which is to be preſerved as long as poſſible, in order to help the rudder, which, in keeping up the movement of rotation of the ſhip, will ſoon make her clear with activity the critical point of the evolution.

EXPERIENCE has often taught me, that the motion of the ſhip, in coming to the wind, at the moment the jib and ſtay ſail ſheets are all let go, is very rapid, provided the other ſails ſhiver; becauſe, the velocity of the ſhip, at that moment, is as great as when all the ſails were expoſed to the impulſion of the wind. Conſequently, the effort of the rudder is likewiſe very powerful (n. 50), ſince the rapidity of ſailing has not diminiſhed.

THE mizen ſail is to be braced up ſo far as to join the main ſhrouds to windward, becauſe in that ſituation it is expoſed as much as it poſſibly can to the wind, and receives conſequently a ſtronger and longer impulſion*; and, again, becauſe it is trimmed for good, and keeps ſo, even after the evolution has been performed. It will not be difficult to conceive that reaſoning for any one of thoſe who are acquainted with the ſituation of that ſail, and who muſt know it cannot be braced but between the aftermoſt main ſhrouds.

THE mizen top-ſail ſhould be filled as ſoon as it is taken a-back, becauſe, being ſuddenly cloſe hauled about for the other tack, it forces

* This is only neceſſary in light winds, when the ſhip's ſtaying is doubtful; and and then the ſpanker boom kept well to windward is of the higheſt utility.

forces the ſtern to leeward, as well as would the mizen (n. 44.), and, by this new diſpoſition, accelerates the evolution. Whereas, if it were left longer in its firſt ſituation, it would retard that evolution, by impelling the after part to windward (n. 45). Another reaſon for not ſuffering the mizen top-ſail to lie longer in its firſt ſituation, is becauſe it is ready ſet and trimmed, fit to be inflated by the wind, when turned about on the other tack, after the ſhip is fallen off, and thus become very uſeful, in moderating the ſtern and lee-way of the ſhip.

At this ſame time, the weather clue and ſheets of the main-ſail are to be hauled up, in order that all may be ready to brace round for the other tack.

The main-ſails are to be filled when the wind is right a-head; becauſe, 1ſt, at this time the ſails on that maſt are becalmed by thoſe of the fore-maſt: 2dly, ſhould they be left longer in this ſituation, they would counteract the head-ſails (nn. 37, 38, 44, & 45.) which are braced up for the ſame tack, and in the ſame manner; and, finally, becauſe, were it not for this manœuvre, the ſine of incidence of the wind on them would be continually increaſing as the ſhip were falling off, which would more and more retard her bearing away. It is therefore neceſſary they ſhould be changed at the moment when the ſine of incidence of the wind which ſtrikes them is leſs than would another greater, by which they would undoubtedly be ſtruck if they were continued longer without being braced about, and than would likewiſe have been the other ſtill greater ſign of incidence by which they muſt have been ſtruck, had they been hauled as ſoon as they were taken a-back; which would have increaſed their power, in giving the ſhip ſtern-way. So that, the moment the wind is right a-head is the moſt favourable to haul about, and fill the ſails, on the main-maſt; for, if this were done ſooner, they would more ſuddenly ſtop the ſhip's head-way, and make her fall to leeward in decreaſing the

the effect of the rudder. It is, notwithstanding, not untrue, that the evolution should be more rapid, if the sails on the main-mast were filled as soon as they are taken a-back: because (n. 44.) they would impel the after part of the ship to leeward. But, this effect of the after sails ought never to be attended to, except when the ship has lost her velocity, and the rudder its power. Whence it must be derived as a conclusion, that the ship will always fall off with great celerity, as soon as the main-sail is hauled.

The jib and stay sail sheets are also to be shifted at this very same time, if they have not been lowered before; because, if sooner, they would take the wind in again, which must not be done before the ship has fallen off sufficiently to clear over the direction of the wind.

The helm is to be righted if the ship has lost her way; because, if it were continued a-lee, as in the first instant, and the ship should get stern-way, the rudder (n. 58.) would oppose the evolution, which cannot miss being finished with sufficient rapidity by the sole effect of the head-sails, as these are now fully exposed to the power of the wind. For great care must be taken not to slack the bow-lines, as is often done by people who act more from custom than reflection.

The head sails are to be filled, when the ship has got over the direction of the wind by 45°, or thereabouts; because, if they were left longer a-back, the motion of falling off the ship would become too rapid, and too great. If they are braced about briskly at the time before mentioned, they may be made to shiver, which, by diminishing their effects, will moderate the great velocity of falling off the ship has acquired (n. 37).

The helm ought to be put a-lee (n. 58.) if the ship goes a-stern, in order to assist her falling off, which is now carried on by the mere *vis inertiæ* only, which causes her to continue to bear away, and by the jib and stay sails before the center of gravity. Thus the

ship

ſhip falls off moderately, in yielding to the wind by 12° or 20° only, more large than if cloſe hauled; becauſe the after ſails, being trimmed ſharp, ſoon bring the ſhip to the wind, and give her head-way (n. 41). Let it not be forgotten, that the helm ought not to be put a-lee in hauling off all, unleſs you judge the ſhip not ſufficiently inclined to fall off, which ſeldom happens when ſhe is come to this point.

OBSERVATIONS.

THE demonſtration of this evolution comprehends the whole play of the ſails and of the rudder; ſo that all other demonſtrations might be conſidered as ſo many corollaries deduced from it.

REMARKS.

THERE are circumſtances ſometimes when it is found neceſſary to tack, without caring much whether the ſhip looſes to windward. For example; when a ſhip is found ſuddenly to be cloſe to the land; in the night, or in foggy weather; near a danger, or ſome veſſel, which muſt inſtantly be avoided by ſtaying the ſhip, becauſe you find yourſelf to windward and too near the object from which you wiſh to recede. In this caſe, when it is neceſſary to deaden the ſhip's way, and tack at the ſame time, you muſt ſuddenly put the helm hard a-lee; and, in the ſame inſtant, let go the jib, fore, and ſtay ſail's ſheets, without touching the bow-lines*; and when the ſails

* Care muſt be taken that the effect of the mizen is preſerved as much as poſſible; if the head ſails take properly a-back and bring her round, the reſt of the evolution is the ſame as in the foregoing problem; but ſhould the ſhip miſs ſtays, proceed according to the ſecond method of veering, called box-hauling†. TRANSL.

† Vide (n. 2.), Chap. III.

ſails begin to ſhiver, the mizen is to be hauled quite in the lee braces: then, if the ſhip takes well the wind a-head, the remainder of the manœuvre muſt be executed as before directed in the other caſe: but if you ſhould come to miſs tacking, we ſhall adviſe what is to be done in the ſecond method of veering.

DEMONSTRATION.

It is eaſily conceived that, in letting go the fore, the jib, and the ſtay-ſails ſheets, the ſhip's head-way will be diminiſhed (n. 46), while, at the ſame time, almoſt all the forces forward are taken away which might hinder her coming to the wind (n. 31.): therefore, the ſhip muſt come to it rapidly by the effect of her after ſails (n. 41) which are trimmed ſharp, and by the power of the helm (n. 50), till all the ſails ſhake. It is alſo eaſy to conceive that when the mizen is hauled in the lee braces, it has a greater power to impel the after part of the ſhip to leeward, and the ſails conſequently to take a-back. So that the ſhip's head-way will the ſooner be ſtopped; and, the fore ſheet being gone, the ſail to windward makes a large cavity between the maſt and ſhrouds; which very much contributes to ſend the ſhip a-ſtern. Attention ought therefore to be paid to catch the inſtant, when the head-way ceaſes, to ſhift the helm and aid the ſhip in her evolution; as we hinted already. The reaſon this method is not always practiſed, is becauſe the ſhip would loſe a deal of ground in driving to leeward, in wearing thus. It ought, therefore, never to be uſed but when neceſſity obliges, and the veſſel has good way through the water; for, if ſhe has not, ſhe will generally by this manœuvre miſs ſtays; in which caſe, you are to act according to the ſecond problem in the following Chapter*.

CHAPTER

* The head bow-lines are never to be checked; the reaſons are obvious to every thinking ſeaman; there is therefore no occaſion for further comment. Transl.

CHAPTER III.

ARTICLE I.

PROBLEM I.

To veer a ſhip, without looſing the wind out of the ſails.

SOLUTION.

TO execute this evolution, both the main-ſail and mizen muſt be hauled up, the helm put a-weather, and the mizen top-ſail a-ſhivering, which will be kept ſo till the wind be right aft, ſuppreſſing for that purpoſe the effect of all the ſtay-ſails abaſt the center of gravity. As the ſhip veers (which ſhe will do very rapidly), round in the weather braces of the ſails on the fore and main maſt, in keeping them exactly trimmed to the direction of the wind, and remembering alſo the bow-lines are not to be ſtarted till the ſhip begins to veer. Then, as ſhe falls off, eaſe away the fore ſheet, raiſe the tack, and gather aft the weather ſheet, as the lee one is eaſed off; ſo that, when the ſhip is right before the wind, the yards will be exactly ſquare, or perpendicular to the keel. Then ſhift over the jib and ſtay-ſail ſheets; and the ſhip continuing her evolution, haul on board the fore and main tacks, and trim all ſharp fore and aft, remembering to haul aft the mizen and mizen ſtay-ſail ſheets as ſoon as they will take the right way, or when the ſhip's ſtern has a little paſſed the direction of the wind. When the wind is on the beam, right the helm, to moderate the great velocity with which the ſhip comes too; the ſails being trimmed, ſtand on by the wind.

DEMONSTRATION.

DEMONSTRATION.

The main-ſail and mizen are hauled up, and the mizen top-ſail ſhivered, in order to favour and facilitate the evolution (nn. 40. & 41). The main-ſail, however, might be excepted from this rule, by letting go the main-ſheet (n. 49.), and manœuvering it like the main top-ſail. The helm is put a-weather, becauſe, in that ſituation, the rudder (n. 50.) cauſes the ſhip to fall off, or yield to the impulſe of the wind, by impelling the after part of the ſhip to windward with ſo much the more velocity as the power of the head ſails exceeds that of thoſe abaft (n. 47), and as, the rapidity of ſailing increaſing, the effect of the helm augments in the ſame proportion. The ſails are trimmed to the direction of the wind, as the ſhip veers, to increaſe her head-way, and of courſe the power of the rudder (n. 58.); which, in great evolutions, is the chief mover, and principal agent of the movement of the ſhip. So that, its effects being augmented, the ſhip's circular motion is of courſe accelerated in the ſame ratio; and, if the wind be well followed, every ſail will be found properly trimmed when the evolution is finiſhed. It follows alſo that, ſince the ſails muſt be kept in a proper ſituation with reſpect to the wind, except the mizen topſail, which, from its ſituation on the after extremity of the ſhip, would retard her veering; the fore ſheet muſt be eaſed off to leeward, and gathered aft to windward, but in proportion as the ſhip falls off. It is alſo evident, for the ſame reaſon, that the bowlines muſt not be ſtarted, till the ſhip begins to veer. When the wind is right aft, the jib and ſtay-ſail ſheets, which are then becalmed by the ſquare ſails, are ſhifted, becauſe the ſhip coming to the wind, they are ready trimmed, and are thereby highly ſerviceable in keeping her under command.

The mizen is hauled out as soon as the ship's stern has passed the direction of the wind, to accelerate her coming to (n. 40.); and the sails fore and aft ought to be trimmed sharp at the same moment, in order to keep to the wind without losing any time. For the above-mentioned reasons is the main tack got on board, and the sheet aft, when the wind is on the quarter. *Q. E. D.*

ARTICLE II.

PROBLEM II.

To box-haul a ship, or the second method of veering.

SOLUTION.

In the performance of this evolution, the most rapid execution is essential. It is done by briskly, and at the same instant, hauling up both the main-sail and the mizen; shivering the main and mizen top-sails; putting the helm hard a-lee; raising the fore tack; letting go the head bowlines, and bracing about the head yards sharp the other way; and letting the jib and stay-sail sheets go in the same instant. When the ship has fallen off 90°, fill the after sails by bracing them square, in order to give the ship a little way, and to help her (with the rudder, the situation of which must be changed) to double the point where all the sails shiver; and, when the wind is aft, you will manœuver for the rest of the evolution as in the first problem of this Chapter.

OBSERVATION.

If the circular motion of the ship, after she has fallen off 90°, should be still sufficiently rapid, the filling of the after sails, to give the ship head-way, may be dispensed with; because she continues to turn by the effect of her helm, which must not be shifted (n. 58), since

ſince the veſſel ſtill continues her ſtern-way. Therefore, after having veered a few degrees more, the wind will fill all the ſails, and the ſhip, conſequently, will have head-way (nn. 35. & 43). Then the ſituation of the rudder muſt be changed (n. 50.), to bring her before the wind; and finiſh the evolution by manœuvering as before.

DEMONSTRATION.

I SAY this manœuvre ought to be performed with the utmoſt promptitude, becauſe it is never practiſed but in critical ſituations; ſuch, for example, as finding the ſhip unexpectedly cloſe to the land, or being under neceſſity to act in preſence of an enemy; or, again, becauſe every thing acts together and at the ſame time, or becauſe the ſhip miſſes ſtays.

THE reaſons for hauling up the main and the mizen ſails, and ſhivering the mizen top-ſail, having been given before, we have only to add, that the reaſon why the main top-ſail is ſhivered, is, that if it were kept full, it would bring the ſhip to the wind (n. 41.), by ſhooting her a-head, ſo that ſhe would almoſt be laid-to. If this ſail were braced a-back, more than perfectly ſquare or perpendicular to the keel, it would ſtill keep the ſhip to the wind, ſince it would be braced the ſame way with the head ſails. Therefore, it would impel the after part of the ſhip to leeward (n. 44), and act in conſequence againſt the power of the head ſails, which ought to cauſe the ſhip to veer rapidly, becauſe they receive the wind on their anterior ſurfaces (n. 37. & 38.) with a very great ſine of incidence. Whence it muſt be concluded, that it is abſolutely neceſſary to keep the after ſails ſhivering till the ſhip has fallen off 90°, or thereabouts; becauſe, then, all the ſails are trimmed and ſhivering in the ſame direction, ſince the head ſails were ſuddenly braced ſharp a-back in the beginning of the evolution to promote the ſhip's veering; and the after ſails have alſo been changed at

M 2 the

the ſame time, by bracing them by little and little to the wind, to keep them ſhivering, as the ſhip falls off. So that, if the ſails have been well manœuvered, they will all be found ſhivering at the ſame time; and, in this ſituation, they no longer act on the ſhip, which will not double this point by the ſole effect of the helm, which was put hard a-lee in the beginning of the evolution, to heave up in the wind, with all poſſible expedition, the ſhip, which, ſoon after getting ſtern-way, falls off rapidly, both by the effect of her ſails, and by that of her rudder, which is well diſpoſed, it is true, for this movement (n. 58), but has not always ſufficient force to cauſe the ſhip to double the point where all her ſails ſhiver, becauſe the wind, being then on her quarter, acts on the whole machine, to ſend her a-head; ſo that, if one ceaſed manœuvering here for a moment, the ſhip would be motionleſs for a time, having loſt her ſtern-way. Now, to put her again in action, and prevent her from driving more than is neceſſary to leeward, fill the after ſails, as mentioned above, to give her head-way, in order that, by ſhifting the helm (n. 50.), the wind may be quickly brought aft.

The jib and ſtay-ſail ſheets are let go, becauſe they tend to draw the ſhip a-head (n. 31).

REMARK.

In a caſe abſolutely dangerous, or when it might be neceſſary to go a-ſtern and fall off ſtill more rapidly, the helm muſt be put alſo as before, and brace all the ſails a-back, having attention not to brace the after ſails more than ſquare or perpendicular to the keel, that they may not counteract the head ſails, which are braced ſharp a-back to pay the ſhip's head off; becauſe, the effect of the after-ſails, in this ſituation, is to impel the ſhip exactly abaft in the direction of the keel (n. 36.); which, with thoſe forward, contributes to give her freſh ſtern-way, in order to cauſe the ſhip to veer (n. 58.) with greater celerity, the helm being a-lee. The

jib

jib and ſtay-ſail ſheets before the main maſt being hauled flat over to windward, will aſſiſt the ſhip in falling off and going a-ſtern, (n. 31).

OBSERVATIONS.

WHEN a ſhip makes a *chapel**, that is to ſay, is taken a-back, by bad ſteerage or a ſhift of wind, ſhe will be brought to the ſame tack again, by inſtantly bracing ſharp round the head ſails, and keeping faſt the jib and ſtay-ſail ſheets. One muſt recollect, alſo, the after ſails are not to be touched (n. 45.) till the ſhip has ſufficiently fallen off; and, when that ſhall be the caſe, trim the ſails and ſtand on as before. The rudder is to be uſed, as occaſion may require, according to the 50th and 58th (nn.), whether the ſhip has head or ſtern way.

CHAPTER IV.

Of lying-to.

THE lying-to is the art of diſpoſing the ſails in ſuch a manner, as that, by counteracting each other, they render the ſhip as it were immoveable with reſpect to the diſpoſition ſhe has, by her form, to divide the fluid, at either extremity, with facility.

BUT,

* A ſhip is ſaid to be chapelling, when ſhe is turned round in a light breeze of wind, being cloſe hauled, ſo as that ſhe will lie the ſame way ſhe did before. This is commonly occaſioned by the negligence of the ſteerſman, or by a ſudden change of the wind. TRANSLAT.

But, as this manœuvre is ſeldom practiſed but under the three top-ſails, it is indifferent whether the fore or main top-ſails be braced a-back, or kept full; becauſe, as theſe two ſails have ſurfaces *nearly* equal, which, by right, ſhould be *abſolutely* ſo, they have the ſame power either to ſtop the ſhip's way, or to cauſe her to run a-head; their poſition being ſuch, that when theſe two ſails act together, or one againſt the other, there is always one tending to pay the ſhip's head off, and the other to keep her to the wind (nn. 32, 37, 41, & 44). But there are alſo other conſiderations to be attended to, when neceſſity requires this manœuvre to be put in practice. For example, when you bring-to to the windward of a ſhip which you wiſh to avoid drifting near, the main top-ſail muſt be braced ſharp a-back, keeping the fore and mizen top-ſails full; becauſe the wind acts with a very ſmall ſine of incidence on a ſail when full cloſe hauled, in compariſon to that with which it ſtrikes it when braced ſharp a-back. So that the fore top-ſail, being full, draws the ſhip a-head, and its power of impelling the ſhip from the wind is ſtopped by the main and mizen top-ſails. She will of courſe not fall off much; nor will her lee-way be very conſiderable; for the ſhip is well kept to the wind, by the diſpoſition given to her ſails.

If occaſion requires to bring-to under the lee of a ſhip, the fore top-ſail ought to be braced ſharp a-back, the main and mizen top-ſails kept full, becauſe theſe two laſt-mentioned ſails tend to give the ſhip head-way, and keep her to the wind; beſides, they may be aſſiſted by the mizen, which is naturally diſpoſed to act againſt the falling off which the ſhip receives from the effect of the fore top-ſail, which is braced a-back, and maintains an equilibrium by counteracting the after ſails. So that, ſhould the ſhip to windward fall off violently, or drift too much, you are more ready to veer ſhort round, and avoid being boarded; becauſe the fore top-ſail being braced ſharp a-back, the impulſe of the wind on it is much greater

greater than if it were full; and is, as a ſail, well diſpoſed to veer ſuddenly, as ſoon as the power of the other ſails ſhall be ſuppreſſed.

ARTICLE I.

PROBLEM I.

To bring-to with the fore or main top-ſails a-back to the maſt, or filled.

SOLUTION.

To execute this manœuvre, the fore or main top-ſails muſt be braced ſharp a-back, and the lee bowline hauled up a little: the other two top-ſails trimmed ſharp; with the mizen hauled out, and the helm a-lee.

DEMONSTRATION.

It has already been demonſtrated, that if the fore or main top-ſail be braced ſharp a-back, while the other remains full by the wind, the ſhip ſtands as if it were immoveable, with reſpect to her velocity, in the direction of the keel; ſince one of theſe ſails prevents the effects of the other, whether to cauſe the ſhip to fall off, or to come to the wind; for, their actions are abſolutely contrary with reſpect to the center of gravity (n. 18.), and very nearly equal; therefore, in this ſituation, the ſhip can but drive to leeward, and will do it at the rate of half a league an hour for the utmoſt.

REMARKS.

If you bring-to with the fore top-ſail to the maſt, you may do it by bracing the head yards only ſquare, which otherwiſe is called perpendicular to the keel. Then, the wind will act obliquely on the

the ſail, and the ſhip will fall off but little, becauſe its effect is only in the direction of the keel from forward aft, and the ſails abaft keep the ſhip to. The main top-ſail may be manœuvered in the ſame manner, if you wiſh not to expoſe yourſelf much to the wind.

ARTICLE II.

PROBLEM II.

To bring-to with the three top-ſails a-back.

SOLUTION.

THE jib and ſtay ſails being hauled down, brace ſharp round at once all the ſails you wiſh to lay a-back in hauling up the lee bowlines, the better to expoſe the ſails to the action of the wind; haul out the mizen, and put the helm hard a-weather.

DEMONSTRATION.

THE jib and all the ſtay ſails are hauled down, becauſe they are before the center of gravity (n. 31.); and the head ſails being braced ſharp a-back, have force enough (n. 37.) to balance the effect of thoſe abaft (n. 44.); which, being braced in the ſame manner, receive the wind with the ſame ſine of incidence as thoſe forward. But, as, in that ſituation, the head ſails have more power to cauſe the ſhip to fall off (n. 12.) than thoſe abaft (which are a little becalmed by thoſe forward) have to bring her to the wind, the mizen is hauled out (n. 40.), and the helm is put a-weather (n. 58.), becauſe the ſhip goes a-ſtern with all the top-ſails to the maſt. It is then proved, that, in this ſituation, the ſails, aſſiſted by the rudder, act the one againſt the other, and balance reciprocally their effects of ſpringing the luff and falling off: and, although the

the ſhip goes a-ſtern and drifts a great deal, ſhe is layed-to; becauſe, in that ſituation, ſhe yields but with great difficulty to the impulſe of her ſails, on account of the reſiſtance of the water (n. 5.) which oppoſes the very great ſurface of the bottom under the lee.

REMARKS.

WAS there any occaſion to wiſh to keep the mizen top-ſail full, it might be done with advantage; becauſe the effect of its acting againſt the other ſails is ſo inconſiderable, that it cannot admit of a compariſon, as its ſurface is hardly half that of the main top-ſail.

IF you wiſh to go a-ſtern without falling off, the fore-ſails are to be laid ſquare only.

CHAPTER V.

ARTICLE I.

PROBLEM I.

To fill, when lying-to, with the fore top-ſail to the maſt.

SOLUTION.

TO fill, and ſtand on, when the fore top-ſail is braced ſharp a-back, you muſt brail up the mizen, hoiſt the jib and fore-top-maſt ſtay-ſail, ſhiver the main and mizen top-ſails; and, when the ſhip has fallen off 20° or 30°, fill the fore top-ſail, which was a-back before, and ſtand on.

DEMONSTRATION.

THE mizen is hauled up, that its effect of keeping the ſhip to the wind may ceaſe (n. 40). The jib and fore-top-maſt ſtay-ſails are hoiſted, to aid the ſhip in falling off (n. 31). The main and

mizen top-fails are fhivered, becaufe their effects are contrary (nn. 41. & 44.) to the movement expected from the fhip. Therefore, every thing, which may caufe her keeping to the wind, ceafing to act, and every thing, which can promote her falling off, now operating, it follows fhe muft fall off with a celerity fo much the greater, as the helm is ftill a-lee (n. 58.), becaufe the fhip goes a-ftern, fince her head-fails are braced a-back, and her after-fails fo difpofed and fhivering, that, when fhe has fallen off fufficiently, the head fails fill, and you ftand on directly.

ARTICLE II.

PROBLEM II.

To fill, when lying-to, with the main top-fail to the maft.

SOLUTION.

BRACE fharp and brifkly the fore top-fail a-back; fhiver the main and mizen top-fails; hoift the jib and fore-top-maft ftay-fails, and brail up the mizen, all at the fame time; and, when the fhip has fallen off 20° or 30°, fill the fore top-fail, that the fhip may ftand on her courfe.

DEMONSTRATION.

THE fore top-fail is braced fharp a-back, in order to caufe the veffel to fall off with greater promptitude, as then it receives a very ftrong impulfion from the wind (n. 37.): as for the reft of the demonftration, it is the fame as in the foregoing problem.

REMARKS.

IF you are obliged to keep the wind on the fame tack as that on which you are lying-to, you have only to right the helm, fill the top-fail which is a-back, and trim it fharp, to continue your courfe.

ANOTHER

Another method would be to trim the top-ſail which was to the maſt, in order to give the ſhip way through the water, and be able to tack, or run large, according as may be found neceſſary. But this method is very tedious, unleſs you mean to heave in ſtays, in which caſe it will be moſt expeditious.

When you lie-to with the main top-ſail a-back, you may fill and continue your courſe by ſhivering it, and the mizen top-ſail, keeping the top-ſail full, righting the helm, and running up the jib and fore-top-maſt ſtay-ſail at the ſame time. As ſoon as the ſhip has fallen off enough to get head-way, fill the after-ſails, and keep the ſhip in the direction you mean to follow. It is eaſily ſeen that this method, though the moſt common, is not the moſt expeditious, when you have to veer conſiderably.

ARTICLE III.

PROBLEM III.

To fill, when lying-to with all the ſails to the maſt.

SOLUTION.

Let the mizen be brailed up, lay the after yards ſquare or perpendicular to the keel, and ſhift the helm a-lee. When the ſhip has fallen off ſufficiently to fill, by her movement, the after-ſails, thoſe forward are then to be braced about and trimmed full alſo, in order to ſtand on in the direction you wiſh to ſteer.

DEMONSTRATION.

The mizen is brailed up, becauſe its effect is to keep the ſhip to the wind (n. 40). The after yards are braced perpendicular to the keel, becauſe, in that ſituation, they have no other effect than that of giving the ſhip ſtern-way (n. 36.), which cauſes her to fall off, ſince they increaſe her velocity in the laſt-mentioned direction,

 the

the helm being a-lee ſo as to turn the ſtern to windward (n. 58). The head ſails are braced about and filled at the ſame time as the after ſails are ſo, that the ſhip may not be as it were laid-to, and that ſhe may get head-way to continue her courſe.

CHAPTER VI.

Of lying-to in a gale of wind.

To lie-to, when it blows hard, is to keep as cloſe as poſſible to the wind, under one ſail only, well trimmed, with the helm laſhed a-lee as much as may be requiſite for the ſhip. And as ſhips commonly bring-to from the ſtreſs of contrary winds, which will not admit of carrying other ſails, care ought to be taken of lying-to under that which will leaſt ſtrain the ſhip; becauſe there are ſome ſhips which behave better under the fore-ſail than the main-ſail; others are more eaſy under the laſt-mentioned ſail; ſome are found to do very well under a mizen; and many veſſels lie-to beſt under a main ſtay-ſail.

Lying-to under a fore-ſail is advantageous for veering (n. 32.) when you are well to windward; but it augments the lee-way, and is more ſubject than any other ſail to cauſe the ſea to break on board, on account of the ſhip's continual falling off: becauſe, in that movement, ſhe gathers way by yielding to the impulſe of the gale, and is afterwards recalled to the wind by the helm (n. 50): ſo that in the ſpringing of the luff ſhe goes up to and meets the wave which comes from to windward, and, as ſhe reſiſts it powerfully, that mutual ſhock cauſes it to riſe, and fall on board the ſhip.

Lying-to under a main-ſail does not ſuffer the ſhip to fall off ſo eaſily as the laſt-mentioned mode, becauſe its effect paſſes abaft the center of gravity of the ſhip (n. 41); but it keeps the ſhip more to the wind, and conſequently occaſions leſs lee-way.

Under

UNDER the mizen, ſhips keep better to the wind, than under any other ſail, becauſe this ſail is farther abaft the center of gravity (n. 40.) than any of the reſt; conſequently ought to keep the veſſel from drifting more than any of the others; but is inconvenient, ſhould you have occaſion to veer ſuddenly.

UNDER the main ſtay-ſail, a ſhip will not make ſo much lee-way as under a fore-ſail, becauſe its effort paſſes very near the center of gravity of the veſſel; but it will however cauſe her to drift more (n. 31.) than the main-ſail (n. 41.): ſo that this mode of lying-to is a mean between the two others, and is preferable when it blows ſtrong enough for that ſail to ſupport the rolling of the ſhip. It ought farther to be preferred, becauſe the ſhip will veer under that ſail, the action of which paſſes at a ſmall diſtance from the center of gravity (n. 31.), and the power of which ſurpaſſes the reſiſtance which all ſhips meet from the fluid under their lee; a reſiſtance which always gives them a great inclination to fly up in the wind, when it blows hard, or when under a heavy preſs of ſail.

ALL theſe different modes of lying-to have, as we have obſerved, their different and peculiar faults: that is the reaſon why, for my part, I prefer being under the fore ſtay-ſail, the main ſtay-ſail, and mizen ſtay-ſail; becauſe, under theſe ſails, the ſhip will ſteer (n. 46.), and is in a better ſituation for veering than under any other ſail; for you have only to haul down your mizen ſtay-ſail, and put the helm a-weather; the two other ſails being before the center of gravity (nn. 30. & 31.) of the ſhip, will cauſe her to fall off, ſhe will then ſoon gather way, and ſteer eaſily.

SHOULD the gale continue very hard, and one of theſe ſtay-ſails be blown away, the loſs is not of a very great conſequence, as you have the courſes, in caſe of an emergency, ready to ſet; whereas it is not always in your power to replace any one of theſe, when you come to looſe them, and you find yourſelf much embarraſſed, particularly in thoſe moſt violent and ſudden ſhifts of wind, when ſhips

ſhips generally looſe every rag of canvas they have ſet*. So that to lie-to under the three ſails above mentioned, to me appears preferable in every reſpect †, whether you wiſh to veer, or keep your wind: becauſe, if you find the ſhip does not ſufficiently keep the wind, you may haul out the mizen (n. 40.), *(which by this time is ſuppoſed to be balanced,)* or take in the fore ſtay-ſail (n. 31.), or even the main ſtay-ſail. One of theſe ſtay-ſails, before the center of gravity of the ſhip, is ſufficient to make her veer as ſoon as the after ones are ſuppreſſed. There are beſides theſe other conſiderations ſtill for ſo doing. The ſhip will carry ſail better; becauſe, as the center of effort of thoſe on her is very low, ſhe drifts leſs, holds a better wind, and goes faſter through the water (nn. 25. & 46.); and theſe three or four ſails are ſituated in ſuch a manner as to give the whole body of the ſhip play; which will ſtrain her leſs than when under one ſingle ſail, which cannot by itſelf work it from aft forward.

DEMONSTRATION.

THE object of lying-to being to keep to windward as much as poſſible, when foul winds, and tempeſtuous weather, prevent you from purſuing your courſe, it follows, as much ſail ſhould be carried, as is conſiſtent with ſafety; and, as you are often unable to ſet more than one ſail, it is trimmed ſharp, that the ſhip may keep her wind as much as poſſible. It is alſo for this reaſon the helm is at the ſame time put a-lee; becauſe the ſhip having but very little way (n. 46.), ſhe falls off, in yielding from time to time to the impulſe of the wind, which acts on her without ceaſing; but,

* IF the fate of the Ramilies, when lying-to under a main-ſail, be recollected, thoſe who looſed theſe ſails only may deem themſelves extremely fortunate.

† SHOULD the ſea run too high for the lower ſtay-ſails to keep the ſhip ſteady, a cloſe-reefed main-top-ſail (particularly if it has four reefs in it to come cloſe down to the cap) will be found to anſwer the purpoſe admirably.

But, as soon as she has fallen off, the vessel is brought to again by the effect of the rudder (n. 50), which cannot fail acting upon her if the water has but ever so little power upon it.

THE same thing happens in lying-to under the three stay-sails (though the ship makes more headway under any other sail), because the effect of these sails is better distributed (n. 46.) than when there is but one of them only set; notwithstanding they have not power enough to procure the ship much velocity, nor to make her steer properly; the helm is therefore put a-lee as in lying-to under any other sail. There are fine sailing ships, which steer very well under these sails, which must be very attentively taken notice of: for, it is always more advantageous to keep the ship under way and lively, than to let her lay motionless at the mercy of the wind and waves.

WHEN the wind is so violent that no sail can be carried, you lie-to a-dry; that is to say, under bare poles and ropes, which serve as and instead of sails, and lash the helm a-lee as usual*.

PROBLEM.

* THERE are hurricanes in the West-Indies which are so dreadful, and which have caused such damages to ships, that I think it is not improper to say a word of them here, especially as I am of opinion that, with a little more caution, care, and skill, in the officers who had the manœuvering of them, a great many accidents might have been avoided, *nay, even prevented*, by observing some of the precepts above delivered by the learned Author of the present Work, and some of our best ships could have been saved and brought back to Europe, which have been totally lost in those latitudes.

IT is in the months of August, September, and October, those most dreadful storms are always to be expected. And, notwithstanding this previous and general knowledge, which they, who frequent those seas, have of what they are to expect, at such a season, I have known a ship attacked by one of those hurricanes which hardly knew where to find a grating or tarpaulin for the hatches; by which neglect the ship was very near being sent to the bottom, had it not been for the utmost exertions of pumping and baling, and a relief still more efficacious, I mean the main, quarter-deck, and forecastle guns, as well as the main and mizen masts, which went

naturally

PROBLEM.

To veer ſhip when lying-to under a main-ſail.

SOLUTION.

ADVANTAGE muſt be taken of the ſhip's falling off to put the helm a-weather, and eaſe away the main ſheet roundly; and when the

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naturally over the ſide at that time. Had it not been, indeed, for theſe lucky circumſtances, the ſhip muſt infallibly have foundered. It is very clear to me that a number of our veſſels have ſuffered from nothing but a want of attention to the important point of the hurricanes ſo common in thoſe ſeas. For, the examples I have ſeen of that, are ſufficient to convince people more incredulous than I am, that, with ſkill, attention, and proper proviſions to guard againſt thoſe accidents, they might ſave the ſhip from being loſt. As a proof, I will quote the very ſame ſhip, which, *ſtrange to tell!* the year following, was, if poſſible, ſtill worſe provided for than the firſt time againſt the hurricane by which ſhe was attacked. And, to illuſtrate this matter, I will attempt to give here a ſhort account of twelve hours proceedings.

THE ſhip riding in Bluefields, in the South-Weſt of the iſland of Jamaica, with one third of a cable on the ſmall bower, and top-gallant yard acroſs, it came on to blow between the hours of three and four in the afternoon; and it gradually freſhened more and more till ſix, when it blew very hard. The ſteps taken to rid the ſhip were ſingular, and ſuch as, I dare ſay, a ſeaman would little dream of. Inſtead of making the neceſſary preparations uſual in blowing weather, and giving the ſhip more cable, another anchor was let go under foot (top-gallant yards ſtill acroſs). Then, at ſeven, ſhe parted the ſmall bower, took the beſt bower on her ſhoulder, and drove off the bank. Now, it was thought expedient to get down the top-gallant yards, which was performed with ſome difficulty, as the ſhip was then lying along ſo that the main-deck guns almoſt touched the water. The top-gallant maſts were next attempted, but too late; for, the gale raged at that moment ſo violently that no man could go aloft. The beſt bower anchor was heaved up; but, for want of being able to ſecure it properly, it was ſoon found neceſſary to cut the cable and let it go. All the neceſſaries for battening down the hatches were now, as the year before, to be looked for. The gratings were however, after a deal of trouble, muſtered up from the different parts of the ſhip to their reſpective places, and the hatches were battened down juſt as might have been expected from ſuch a ſituation, which was very unfit for that operation; ſince it required the whole and conſtant effort of the pumps to free the ſhip of the water which was pouring down through the hatchways. But

the ſhip has fallen off about 30°, the bowline is to be let go, and the weather brace rounded in, taking care to keep the ſail full. When

But, what elſe could be expected in ſuch a circumſtance? This ſo eſſential piece of ſervice had never been thought of till the ſhip was almoſt on her beam ends from the violence of the wind; and much indeed cannot be expected from the execution of the carpenter's hammer, when he himſelf, amidſt ſuch a dreadful warring of the elements, and the horrors of a night as dark as Erebus, is deprived of all the faculties of his ſoul by fear, and of his body by the rolling of the ſhip; for no one can ſtand faſt.

By this time, the hurricane was become dreadful beyond conception; its action was like that of fire: every thing diſappeared which oppoſed it; and the maſts, notwithſtanding their ſize and ſolidity, powerfully ſupported by the rigging, were no longer able to reſiſt its unremitting fury. The mizen maſt went firſt; in about two minutes afterwards the main maſt followed; and, inſtantly after, went the fore-maſt and bowſprit. This moſt diſtreſsful ſituation of the ſhip is undoubtedly more eaſy to conceive than to deſcribe: terror and aſtoniſhment, for an inſtant, ſeized every mind, oppreſſed every heart. But, this ſtupor was only momentary, and was ſoon overcome by that intrepidity and indifference to danger which ſo eminently characteriſes Britiſh ſeamen; and the wreck, conſidering the tremendous concurrence of the winds and waves againſt ſuch an operation, was however cleared away with wonderful alacrity.

About this time, the wind chopped round to the Southward, and raiſed a moſt dreadful ſea. The tiller was now carried away; but its place was ſoon ſupplied by the ſmall one in the cabin. The ſhip continued to drift all night, with the pumps inceſſantly going. At the break of day, the land was ſeen right under the lee, about two miles diſtance. The aſpect of this land was however far from being pleaſant, as it was high ſteep rocks, and there were no ſoundings near them. Of ſaving the ſhip, hardly a ray of hope now remained; for, the wind, though much abated, ſtill continued to blow with great violence dead on ſhore. The fore-maſt, on which was hoiſted a mizen top-gallant ſail, was gone about twelve feet above deck. The ſtumps of the main and mizen maſts were about the ſame height; upon which, while employed to get ſails ſet, the wind providentially ſhifted from South to Eaſt, which, co-operating with a moſt rapid Weſterly current running on ſhore, cleared the ſhip of the rocks, by making her paſs them within about two cables lengths.

Now, notwithſtanding the dreadful violence of thoſe hurricanes, let us examine whether, by proper precautions, their tremendous effects might not be greatly palliated.

When the ſhip is before the wind, get on board the main tack, and right the helm, to moderate her coming-to, and trim all ſharp in order to keep her to.

IF,

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liated. For example, let us ſee what ſhould have been done before the gale was become outrageous, for there was time ſufficient to do a great deal of buſineſs, as it came but ſlow, and gradually. Firſt, on finding the approach of this dreadful tempeſt, inſtead of driving to ſea with top-gallant yards acroſs, the top-ſail yards ſhould have been taken down upon deck, and the top-maſts lowered cloſe down, and their heels well ſecured. The rigging ſhould have been made ſnug and firm on the tops; the ſprit-ſail yard and jib-boom taken in; and the croſs-jack and mizen yards lowered down. Good down-haul tackles ſhould have been fixed to the fore and main yards, to get them down and ſecured cloſe to the gunwale as ſoon as they are found of no further uſe than to ſtrain the maſts. The ſhrouds alſo ſhould have been well ſwifted if ſlack, the booms and boats well frapped, the hatchways well ſecured, the lower-deck guns double breeched, coined, and ſecurely muzzle-laſhed. The ſpare tiller ſhould have been at hand, with the relieving tackles ready in the gun-room, in caſe of accident to the tiller rope. The fore locks of the main deck, forecaſtle, and quarter-deck guns ſhould have been looſened, ready for their being thrown overboard, in caſe the hurricane ſhould continue any conſiderable time, and by its violence much weaken the ſhip; as was the caſe, to a moſt perilous degree, with his Majeſty's ſhip HECTOR, in the violent hurricane of the year 1780; when, in order to prevent her foundering, ſhe was obliged to throw every gun ſhe had into the ſea.

EVERY thing being now thus in order, and quite ready or prepared againſt any accident which may happen, if you think, from the appearance of the weather, you have time to lift your anchor, let it be done, as it may be of eſſential ſervice before the gale is over; if not, cut and run, for fear, by a ſhift of wind, you ſhould get dangerouſly land-locked.

THE lower yards are ſtill to be kept aloft, that the courſes may be ſet if the force of the wind will admit, to enable you with all poſſible expedition to get clear of the land. Then, when you find you have got a ſufficient offing, the yards are to be lowered down and ſecured to the gunwale.

BUT, ſhould the gale be too far advanced to allow the courſes to be ſet, the ſhip may run off before the wind under the lower ſtay-ſails, as the ſea is yet (comparatively ſpeaking) tolerably ſmooth, ſince the wind is off the land. And, when the gale becomes too powerful for the ſtay-ſails, they are to be hauled down, and ſecurely ſtowed, to prevent their being blown away. Then the ſhip, under her bare poles, will

run

If, in the beginning of the evolution, the ſhip is difficult to veer, the fore-ſtay-ſail may be hoiſted and the ſheets hauled well aſt: but it is to be hauled down as ſoon as the ſhip is before the wind.

DEMONSTRATION.

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run before the wind with a ſufficient rapidity to get at the neceſſary diſtance from the ſhore. That point being obtained, laſh the helm a-lee, and wait for the event.

What is here recommended to be done, in ſtriking maſts and yards, and carrying ſails off ſhore, muſt be conſidered as a mere intimating of what might have been executed on board the ſhip firſt mentioned, conſidering the ſituation of the land and the progreſs of the gale; for, we are well appriſed that different times and different ſituations render different manœuvres neceſſary.

One thing, however, is brought by experience to a very great point of certainty; *viz.* that the weight aloft muſt be very much diminiſhed if you want to ſave the lower maſts: that is to ſay, that the top maſts muſt be lowered down as well as the lower and top-ſail yards. If this cannot be done, they muſt, if poſſible, be cut away, or the loſs of the lower maſts is unavoidable; a weighty conſideration, as, (not to mention the riſk the ſhip runs from a total inability to manœuver, while the violent ſwell, which always is the conſequence of thoſe tempeſts, continues,) if we conſider again how often the extreme motion of the ſhip renders all attempts to get up the jury-maſts abortive, it will appear moſt evident that the preſervation of the lower maſts is of the higheſt conſequence abroad.

Getting the lower yards down and ſecured to the gunwale is certainly in the power of every ſhip, if it be, but in proper time, put in execution, and eſpecially as (which is another conſideration of the higheſt importance) a line of battle ſhip's main-yard very frequently cannot, in a remote country, be purchaſed, and even granting it might be had, ſuch a purchaſe cannot fail being attended with loſs of time and delay; and that is always prejudicial to the ſervice.

In order ſtill farther to evince the indiſpenſable neceſſity of relieving the lower maſts, let us now recollect how in the year 1780 there was not a veſſel, which came within the ſweep of the hurricane, but was diſmaſted; among which were reckoned eight or nine ſail of the line*; a proof that the largeſt ſhips are not the more able to ſtand its fury. The following year, the very ſame thing happened again; and, out of three men of war which were at ſea on that ſtation, one was abſolutely loſt, and the other two, after being diſmaſted, were ſaved but by the moſt miraculous interpoſition of Providence†.

Had

* Admiral Rowley's ſquadron.

† His Majeſty's ſhips Ulysses and Southampton. The Pelican was loſt on *Morant's Keys* on the ſame night, being the 1ſt of Auguſt, 1781.

DEMONSTRATION.

The reaſon why, to execute this evolution, an opportunity muſt be taken of the ſhip falling off, is becauſe that motion of the ſhip gives her way, and makes her of courſe better diſpoſed to gather way. For that very ſame reaſon alſo the helm is then put a-weather (nn. 50. 58.), and the main ſheet eaſed off roundly (n. 49.), that that part only of the ſail which is before the center of gravity of the ſhip may be left to act. The main bowline is kept faſt till the ſhip has fallen off 30° at leaſt, and then let go directly, becauſe the wind is then more eaſily kept in the ſail, the velocity of the ſhip increaſed, and conſequently the power of the helm (n. 58.) and the movement of evolution are alſo accelerated (nn. 16. 17. 18.). By hauling in the weather brace, you follow the wind with the ſail;

Had the precautions, I have juſt before mentioned, been taken, I cannot help thinking the maſts might all have been preſerved, and the ſhip and her crew leſs expoſed to a lee-ſhore, which was like to have proved fatal to the whole.

The ſea being then covered with wrecks, againſt which ſhips are very apt to run in the night, there wants but ſuch an accident happening, joined with the violent motion of the ſhip, to make a butt-end ſtart; and if, in ſuch a caſe, a quick remedy is not found, it is clear that, in ſpite of all the pumps, the conſequences muſt be fatal. On this occaſion, I muſt here mention what (as I have been informed) anſwered once moſt admirably the purpoſe of remedying ſuch an accident.—— A Receipt.—Take a ſtudding ſail, or ſome ſuch ſmall ſail; then take a quantity of oakum, horſe-hair and wool, if they can be got, which chop ſmall and well mix together: when done, make a compound of it with hay or ſtraw, cut very fine, and mixed with lime and any dung or filth you may happen to have on board: then ſtick this in handfuls to the ſail as lightly as poſſible. The ſail being thus prepared, haul it under the ſhip's bottom with ropes ſo faſtened to the ſail as to keep it extended. The ſuction which promotes the rapid entrance of the fluid into the leak will draw the compoſition from the ſurface of the ſail and force it into the fracture, in ſuch a quantity as, if not intirely capable to ſtop it, will generally however keep out ſo much of the water as to render the danger very trifling.

N. B. This Note is not in the Original, nor is it the Tranſlator's own production; but has been furniſhed by an Engliſh Officer diſtinguiſhed for his nautical abilities.

ſail; and, when the wind is right aſt the yard, that ſail will, by that means, be found perpendicular to the keel, or, in other words, ſquare. To trim it, you have but to eaſe off the brace and bring the tack on the ſame board as you take the wind; an operation for which you have full time ſufficient, as, by righting the helm, you moderate the velocity with which the ſhip flies to the wind, ſince by that action the effect of the rudder is totally ſuppreſſed.

REMARKS.

THERE is another method of veering ſhip under a main-ſail, which may eaſily be practiſed. You make faſt a three or four inch rope *(in proportion to the ſize of the veſſel)* to the ſlings of the main yard; and, when the ſhip comes-to, ſo as to ſhiver the main-ſail, bring it down before the ſail to the top-ſail-ſheet bits, and let it be hauled well taught and belayed. Then, as ſoon as ſhe falls off, the helm is to be put a-weather, as above mentioned, and the main ſheet let go. By that means the lee part of the ſail no longer has any power to keep the ſhip to the wind, and the weather part acting before the center of gravity will cauſe her to veer faſter than by the firſt manœuvre; though, in general, that firſt manœuvre will hardly once miſs to anſwer the purpoſe.

To veer a ſhip under a hull or her bare poles, the fore-ſtay-ſail muſt, if circumſtances will allow it, be hoiſted (n. 31.). But, if that cannot be done, the head yards are to be braced up as ſharp as poſſible, and thoſe abaft pointed to the wind, or parallel to its direction. Then, if the ſhip veers, ſhe will ſteer under the maſts and ropes only. A certain quantity of ſeamen, ſent up and placed cloſe to each other in the fore ſhrouds to windward, will, in a caſe of this kind, be found alſo of very great ſervice.

CHAPTER

CHAPTER VII.

ARTICLE I.

PROBLEM I.

Of sounding in fair weather.

SOLUTION.

If close hauled, brail up the mizen and mizen stay-sail, let fly the main sheet so as to have the sail shiver, put the helm a-lee, and back the mizen top-sail by bracing it perpendicular to the keel. The head-sails, as well as the jib and stay-sails, are to be kept in their first situation; one must only have care to haul taught and belay the lee braces; and, as soon as the ship has very nearly lost her headway, though continuing still to come to the wind, you catch that moment to heave the lead, and haul it in again with all possible dispatch as soon as you have touched the ground. Then, you may fill and stand on again by hauling aft the main sheet; trimming the mizen top-sail, and righting the helm.

DEMONSTRATION.

The mizen and mizen stay-sail are brailed up, because their effect to bring the ship to the wind would be too powerful (n. 40). It is also for the same reasons the main sheet is let go (n. 41.), though there is another besides this which is that it destroys the equilibrium which existed between the sails forward and the sails aft (nn. 46. 49.); whence the rapidity of sailing is diminished, as well as the effect of the helm, which acted (n. 50.) to bring the ship to the wind, while at the same time it opposes her velocity (n. 59). The mizen top-sail is braced a-back, and perpendicular to the keel, to impel the ship a-stern in the direction of her length (n. 36.); so that her headway being now much diminished by the new disposition

tion given to the forces which are to produce it, the ſhip, by the effect of the rudder, ranges to the wind ſo far as to cauſe to ſhake the main top-ſail and the ſails on the foremaſt, which, to that very moment, had acted to keep up the celerity of ſailing (nn. 32. 41). But, as the effect of the rudder is very faint, ſince the velocity of the ſhip is greatly diminiſhed (n. 58.), when the ſails have loſt their action, it follows the ſhip muſt ſtop, and is not able to come ſufficiently to the wind, to bring her about, becauſe the jib's and ſtay-ſail's ſheets being hauled aſt, oppoſe the effect of the helm (Art. 31.); ſo that ſhe reſts as it were motionleſs for an inſtant, which muſt be ſeized to throw the lead with the greateſt diſpatch; becauſe, ſhould the ſhip come to fall off by the effect of her jib and ſtay-ſail, which are the only ones in action, the other ſails might ſuddenly fill and give her headway, which would prevent you from getting ſoundings, were you too dilatory in throwing the lead. Whether you do, or do not, find any bottom at all, in hauling in your line as faſt as poſſible, you muſt ſeize the opportunity of the ſhip falling off, to fill and ſtand on again.

Should the ſhip, in ſpite of the diſpoſition here given to her ſails, come head to wind (which could not happen but from her having preſerved ſome velocity), the helm muſt continue to be kept a-lee, but the head-ſails ſhould quickly be laid ſquare or perpendicular to the keel, and the jib and ſtay ſails hauled down; then the ſhip will ſoon after be found to veer.

REMARKS.

In going large, you have only to put the helm a-lee, without forgetting to brail the mizen up, and to belay the lee braces quite taught, to prevent the yards having too much play when the ſails are ſhivering. It is impoſſible ever to tack in this ſituation, as the jib and head ſails are always in action (n. 31.); and the ſquare ſails ſoon coming to ſhake, on account of their ſheets not being tacked, they

they loſe all their power: therefore, nothing working for the ſteerage way, the ſhip is ſoon at a ſtand.

ARTICLE II.

Another method, preferable to the former.

If the depth of water were conſiderable, as 80, 100, or 200 fathoms, and you wiſh to ſound ſmartly and with exactneſs, you had only to brace the head-ſails perpendicular to the keel, when going large, haul down the jib and ſtay ſail, without ſtirring the after-ſails, and put the helm a-lee; and, while the ſhip has ſtill a little headway, you heave the lead from the ſame place you haul it in; that lead will go firſt a little a-ſtern; but the ſhip being head to wind, will herſelf go a-ſtern likewiſe right upon the line which, by its own proper gravity, happens then to be juſt a-peek: and, as the helm is a-lee, the ſhip eaſily veers. But, if you wiſh to keep her to longer, you have only to right the helm, and haul the mizen out, to prevent the ſhip's falling off.

If you have ſtudding ſails ſet, they muſt be hauled down, particularly the lower ones; becauſe, ſhould the wind take them a-back, their power on the boom might bring the ſhip round entirely: for, they act on a lever without the ſhip, the fulcrum of which is on the outſide of the veſſel before the center of gravity. If, however, the helm is continued a-lee till the ſhip falls off, ſhe will not come about, becauſe then the veſſel goes a-ſtern with great velocity, and the rudder acts powerfully to make her veer; but the fact is, that the ſhip will go a great deal ſtern-way, and continue ſo much longer.

If cloſe hauled, or a very little from the wind, the helm is to be put a-lee; and, the inſtant the ſails are taken a-back, the head-ſails are to be filled by bracing them briſkly perpendicular to the keel, without waiting for the wind being right a-head; then, a little before the ſhip has loſt her way, you heave the lead from the ſame

same place you haul it in; and as for the rest you manœuver as before mentioned.

CHAPTER VIII.

On chasing.

THAT a ship might chase another, she ought to have the advantage of sailing. We shall therefore always suppose that the chaser sails better than the vessel chased; because, were the ship chased as good a sailer as the chaser, she never could come up with her, if they manœuvered equally and at the same time, however full of skill and ability the manœuvre of the chaser might be. It is then useless to follow a ship over which you have not the superiority in sailing, unless you find, from the manœuvre of the chase, she does not know how to take the benefit of her equality.

To know if your ship has any advantage in sailing, you must get on the same tack, under the same sails, and keep the same course with the vessel you mean to chase, and set her exactly with a compass. If you sail best, the chase will soon be drawn a point more aft; but, if she has the advantage, you will in a short time bring her a point farther forward than the first bearing: if you sail equally, she will remain on the point you set her at first, supposing you keep the same course*.

ARTICLE

* THIS method, it is true, will shew the difference of velocity between two ships under certain sails; but, though the chase may have the advantage under a certain particularly-disposed portion of canvass, she may not have the same superiority with all sails set. For, it is well known that some ships sail (within a very little difference) as well under their three top-sails, as with all the surface they can expose to the action of the wind; while the celerity of others will be multiplied two or three times, and frequently more. Without trying this experiment, sail ought therefore, in my opinion, to be made instantly, and with the greatest celerity possible, on discovering any strange vessel.

ARTICLE I.

PROBLEM.

To chase a ship to windward, and the shortest method of joining her.

SOLUTION.

WHEN the chaser finds himself to leeward of the vessel he means to pursue, he ought to continue on the same tack as when the enemy was first perceived, till he brings her to bear exactly perpendicular to his course (if he has not however already passed that point): then tack, and continue the second board till he again brings the chase, perpendicular to the direction on which he is standing by the wind (or on his beam), or he must then heave about again; and always continuing the same manœuvre, by tacking every time he brings the chase perpendicular to his course on either board: and, by manœuvering in this manner, it is very certain that the chaser will, by the superiority only of his sailing, join the other by the shortest method.

DEMONSTRATION.

WHEN the ship A (*fig.* 20.) chases the ship B, which is three leagues to windward, with one fourth advantage of sailing, the chaser is not to tack till he reaches the point C; because he will then have the ship B, right on the beam at the point D. He is, then, to continue, on the tack C E, till he brings the chase perpendicular to his course at the point F. The ship A is to continue thus to manœuver every time she brings the vessel B right a-breast of her, whether the chase continues on the same tack or not; and thus the chaser will join the other at H, so that she will be able neither to change her course, nor recede from him.

YOU continue on the same tack as when the enemy was first seen, first in order not to lose time, because there is no fear of your bringing always the ship you are in chase of right on your beam, when

when you have a superiority of sailing, whatever may be the tack she is on, provided you are always particularly careful not to pass that point; for, if you did, there would not be a moment to lose before you get on the other tack with all possible dispatch.

The chaser heaves about as soon as the vessel he is in pursuit of is perpendicular to his course, or on the beam; because she is, at this time, at the shortest possible distance, if he chases on the same tack and steers the same course with the vessel chased. If the chaser runs on a different tack from the vessel chased, he is still to tack when the flying ship is on his beam, because the distance is the least possible between them on the different boards they hold. It is then evident the chaser cannot better manœuvre than by tacking every time he brings the ship which is avoiding him perpendicular to his course, since he never passes the shortest distance possible between the two vessels on the same or different boards they hold with respect to each other.

REMARKS.

In manœuvering, as we recommended above, you will be under the necessity of making a good many more boards than if you chased by the ordinary methods: but, this quantity of evolutions is always advantageous to the chaser if the ship be well managed, and the sails hauled smartly; then she will always gain to windward, in stays, as is found from experience, when the above principles are adhered to, and the ship handled with sufficient dexterity.

The manœuvre here prescribed for the chasing ship, is preferable to all others, not only because it is the shortest, but because you force the ship you are in chase of to fly from you close upon a wind, in pressing her more and more from the leeward, by never passing that point before mentioned, the shortest way possible between the two vessels in plying to windward.

ARTICLE II.

Observations for the ship to windward, which is chased.

The weather ship, which flies, will always be joined by the chaser, notwithstanding every manœuvre she may execute, since it is granted she does not go so well as the vessel which pursues: it is therefore to her advantage constantly to keep the same course without losing her time to heave about, as tacking cannot be so favourable to her as to her adversary, whose sailing is superior.

If the chaser should so little understand his profession as to stand on a long way, and tack in the wake of the chase, the best thing she can do is to heave in stays, and pass to windward of him on the other tack (unless you suppose your vessel would have a superiority large); for if the chaser persists in tacking in the wake of the other ship, it is an unquestionable fact, that the chase will be very much prolonged.

I shall not here pretend to foresee or give a detail of all situations in which a ship may be engaged in being chased, either by one or more vessels; it would be an absurdity in me to attempt it. I shall, therefore, content myself with offering some of these pressing and general circumstances, persuaded the genius of an attentive officer will always suggest to himself the properest means of extricating his ship from the most difficult situations.

ARTICLE III.

PROBLEM.

To chase to leeward.

SOLUTION.

When to windward of a vessel you wish to chase, keep the ship away to cut her off; and, steering continually in the same direction, you come at last together at the point where the courses run by the two

two vessels intersecting each other. This principle will be exactly executed by the chasing ship, if, in the course she has chosen, she constantly keeps the vessel she is in chase of, on the same degree of the compass, as in the beginning of the chase. This principle is always the same in all the courses the retreating ship steers; for, no overtaking can be executed but by keeping on a strait line, which is the shortest possible which can be drawn between any two points.

DEMONSTRATION.

Should you take another course than that which keeps you in the same point of bearing you were in with respect to the vessel pursued, at the beginning of the chase, you would miss your aim, by being too far a-head or too far a-stern; that is to say, if the chaser keeps his wind too close, he will be too much a-head, and consequently prolong the chase; and, if he keeps too much away, he will be too far a-stern. These are the only two considerations to be made when this problem is to be executed; considerations easy to be observed, and corrected with an azimuth compass; because, when you see that at the end of a certain time you bring the chase more aft, than her first point of bearing, it is evident you keep your wind too much; if, on the contrary, you draw her forward, it is a certain proof you keep too much away. Now, these inconveniencies are very easily remedied, by steering for the first case, so as to see that the ship chased is always kept exactly on the same degree of the compass; and, for the second, you keep your wind a little more, till you see that you rest always on the same point of bearing with respect to one another. Then, it is evident, you chase by the shortest and most certain method, since you reach the chase, in running on a strait line.

REMARK.

As, in the case proposed, the chaser is to the windward of the ship chased, he veers as much as possible, and so as to keep the enemy always in the same point of bearing; but it might happen, that

that (by veering on the ſhip which flies) having found the poſition in which ſhe remains always on the ſame point of the compaſs, there could exiſt, by veering yet more, a poſition ſtill more advantageous than the firſt; becauſe your velocity may be increaſed, as much as you prolong the lines which you run over between the parallels of like bearing which you make in the courſe of the chaſe, to ſee if you do not ſwerve from the firſt.

ARTICLE IV.

Remarks for the ſhip which is chaſed.

WHEN a ſhip, being to leeward of another veſſel which gives her chaſe, is obliged to fly, ſhe ought to run on the courſe that will carry her moſt immediately from the chaſer, and, in general, conſult which is her beſt ſituation with reſpect to the wind, that ſhe may move with the greateſt rapidity poſſible from the ſhip which purſues her. For, ſome veſſels have more advantage in going large than others; ſome with the wind right aft; and others, again, are to be found which go beſt cloſe hauled. So that attention ſhould be paid by the officer to the known qualities of his ſhip, in order to take the moſt advantageous and convenient directions capable to effect a retreat. However, it is near a certainty, that if the chaſe does not ſail at leaſt at an equal rate with the chaſer, whatever manœuvre ſhe may put in practice, ſhe will always be overtaken by a ſkilful chaſer adhering to principles. But, that there may be no room left for ſelf-reproach, every thing poſſible is however to be done to avoid ſinking under a ſuperior force, by taking advantage of every occurrence which offers: and, when you ſee the enemy will unavoidably come up with you, and that the event can no longer be deferred, heſitate not to attack with confidence and reſolution, and put to proper uſe the little force you have. Thus, it often happens that the heat of the enemy is cooled by ſuch an anticipated attack, and that intrepidity, ſupported with ſome favourable circumſtances, ſucceeds.

CHAPTER

CHAPTER IX.

Of Boarding.

BOARDING, in the ſenſe in which it ought to be underſtood, is at once an action of vigour; and the art of approaching the ſhip of an enemy ſo near, that you can eaſily (and in ſpite of him) heave on board your graplings, which are to be ready on the lower yard-arms, forecaſtle, gangways, &c, &c; for the purpoſe of being thrown into the enemy's ſhip by hand, as ſoon as along-ſide, in order to confine the veſſels together, and give the people an opportunity of getting on board, to carry the adverſe ſhip ſword in hand.

BUT, it muſt be conſidered that, between two ſhips which are engaged, it is generally the caſe that boarding is more advantageous to one than to the other; ſo that the one has an intereſt in endeavouring to board, and the other in avoiding being boarded. This difference of force, and way of thinking, renders the execution of this manœuvre difficult; whence it follows, that for both parties there are diſpoſitions which may be better concerted than others. This is what I mean to diſcuſs in the following Problems, which cannot be ſufficiently extended to take in all the many and various incidents inſeparable from ſituations of this kind. It will, therefore, be the buſineſs of the officers to avail themſelves of the advantages which occaſions and circumſtances will offer them naturally, or to procure them by their ſkill and the ſuperiority of their manœuvres.

ARTICLE I.

PROBLEM.

To board to windward, or avoid being boarded.

A SOLUTION DEMONSTRATED.

IF a ſhip wiſhes to board another which waits for her in keeping her wind under an eaſy ſail; or one which does not ſhorten ſail, but

but over which ſhe has the advantage of ſailing; ſhe muſt get on the weather quarter of the ſhip ſhe means to board, within half a piſtol ſhot. Then ſhe muſt begin the action, and continue it with a ſteady vivacity, to cover her manœuvre by the ſmoke of the cannon and muſquetry of both ſhips; then, under the cover of this cloud, let her make more ſail if ſhe has not way enough, in order to augment the velocity of the ſhip and the rapidity of her movements, that ſhe may with greater promptitude lay her enemy on board on the weather ſide, exactly a-breaſt, or a little abaft, no matter. This is very eaſily executed, by edging down unexpectedly upon her ſo as not to expoſe yourſelf however to be raked by the enemy's fire from to leeward. The ſhip boarded by this manœuvre can hardly ſuſpect that deſign but at the moment, or very little before, the grapnels will be on board of her. In this ſituation the boarded veſſel has but one doubtful expedient to try, in order to extricate herſelf from the perplexity in which ſhe is engaged, and which even will be of no ſervice if the boarder obſerves her well. For, the moment ſhe braces ſharp a-back her head-ſails, to cauſe the ſhip's falling off (n. 37.), and ſquares thoſe aft (n. 36.) to give her ſtern-way, the boarder has only to perform briſkly the ſame manœuvre, and they will then be both as near for boarding as before, provided the boarder be very quick in feeling the impulſe of her ſails and helm, which ought to be put a-weather (n. 50.) and kept ſo till the ſhip's headway ceaſes, when it is to be put a-lee (n. 58.), to aſſiſt her in falling off, in manœuvering as in box-hauling (Chap. III. Art. 2.), in order to board the enemy to leeward; for, the boarder ought to be on the quarter of the other, ſince at the moment the two ſhips were right before the wind, ſhe who was firſt to windward, and wiſhed to board, had only to continue her movement of rotation, and render her velocity equal to that of her adverſary, by ſhortening ſail in order not to paſs her. Now, if the circular motion is kept up by the boarder, which at firſt cauſed

him

him to fall off, and now brings him to the wind on the other tack, he will join the enemy to leeward; for, it is evident that if this motion of turning be more rapid than that of the ſhip which wiſhes to avoid boarding, the boarder will cloſe her before ſhe can range to the wind on the other tack, ſince he (the boarder) comes round with greater celerity. However, if the ſhip which fears boarding was preſſed as cloſely as is here demonſtrated, ſhe would have no other poſſible manœuvre to execute, but to throw once more all her ſails to the maſt, by bracing them only perpendicular to the keel to give her ſtern-way (n. 36.), and putting the helm a-weather, to keep her to the wind, as ſoon as her head-way ceaſes (n. 58.); obſerving that, ſhe being to windward, this manœuvre may cauſe her to drive on the boarder, as he is then looking for her under her lee. As there is no other reſource, neceſſity obliges her to hold to this expedient; becauſe, could the ſhip which is attacked go a-ſtern with a ſufficient velocity, ſhe might let the boarder paſs a-head, veer under his ſtern, and rake him, if he is not as quick as the other to foreſee this manœuvre, and as nimble in manœuvering in the ſame manner as the enemy's ſhip: becauſe, the great velocity with which he comes to the wind and goes a-head (his ſails being ſtill all full), puts him in this bad ſituation, which may prevent his perſiſting in the inclination of boarding. It is however very clear that the boarder will attain his purpoſe, if he takes care to throw all his ſails a-back at the ſame time as the ſhip to windward; becauſe, the attacked ſhip dropping to leeward, and having ſtern-way firſt, approaches a little the boarder, who has ſtill preſerved his poſition on the quarter, and longer kept his luff, by having gone a-ſtern ſomewhat later than the weather ſhip. But, it is farther to be obſerved, that when the two ſhips are right before the wind, if the veſſel which fears boarding moves quicker to the wind than the one which attacks, ſhe will avoid it, as the retreating ſhip will be cloſe to the wind before the other, and able to get

a-head of her by making all ſail to keep her wind, or to heave in ſtays and get upon the other tack. But, it muſt be conſidered that this laſt movement is an unfavourable one; as, by ſo doing, you will preſent your ſtern to a ſhip, which no doubt will take advantage of your ſituation, and rake you; which might be more deſtructive to you than a well-oppoſed attack by boarding.

THERE is however no doubt that if the ſhip inclined to board, ſails better than the other, it will always be in her power to execute that deſign, if ſhe has as great a knowledge of manœuvering as the ſhip which flies.

ARTICLE II.

PROBLEM.

To board to leeward, when cloſe to the wind, or to avoid being boarded.

SOLUTION DEMONSTRATED.

IN order to execute this manœuvre, the boarder is to come within piſtol ſhot, cloſe in the wake, or, at moſt, to the weather quarter, of the ſhip he means to attack; taking care to continue ſteering, as much as poſſible, ſo as not to be raked by ſome of the guns which belong to the quarter he ſtands on. Then, to come up with his adverſary, he muſt edge away a little, and range round aft ſo cloſe upon the enemy's lee quarter, that his cat-head may almoſt touch her quarter gallery. Now, when you have heaved ſhort ſufficiently a-head, and ſo (your ſhip being ranged parallel to your adverſary's) as to bring your forecaſtle abreaſt of your enemy's main-maſt, the mizen and mizen ſtay-ſail ſheets are to be hauled well aft, the helm put hard a-lee, and the head ſheets let fly; then, your ſhip, coming rapidly to the wind (nn. 40, 50, & 31.), ſhivers her ſails, and cloſes the oppoſing veſſel ſide to ſide. This manœuvre is infallible when you have the advantage of ſailing, provided very great attention is paid to it. I ſay here great attention is neceſſary: for,

for, if at this moment the weather ſhip, which wiſhes to avoid boarding, ſets her courſes, or lays all thoſe flat a-back which ſhe had ſet, ſhe may by one of theſe two manœuvres break the grapnels you have thrown on board of her, unleſs you had the care to diſpoſe your ſails in the ſame manner as hers: becauſe the boarded ſhip, by making more ſail, will, if the wind be a little freſh, ſhoot a-head through the water, and the boarder will be dragged with ſuch a violence as to break the chains or hawſers with which the ſhips are confined together. By laying all flat to the maſt, the boarded veſſel has ſtill a better chance of ſucceeding, ſince the ſails of one of the two ſhips will be full while thoſe of the other are a-back.

SUCH a ſort of boarding may, as has been demonſtrated, be anticipated and avoided, if the boarder does not pay the ſtricteſt attention to his own manœuvres as well as to thoſe of his adverſary: but it may be with ſtill more advantage avoided, if the laſt mentioned veſſel braces her head-ſails ſharp a-back, ſetting only, if neceſſary, the fore-ſail (n. 37.), laying at the ſame inſtant all thoſe abaft to the maſt perpendicular to the keel (n. 36.), or ſhivering, as you may have more or leſs occaſion for ſtern-way, and putting at the ſame moment the helm hard a-lee (n. 58.) All this is to be executed when the boarder is ſtill about a ſhip's length (more or leſs) a-ſtern of the veſſel which is to perform this manœuvre. The quickneſs of this evolution, and the rapid veering of the weather ſhip which puts it in practice, may bring the veſſel inclined to board, and who is a little to leeward or a-ſtern of the other, into the moſt dangerous ſituation, if ſhe does not manœuver in the ſame manner and with equal celerity; as the boarder's ſails, being full, keep up his velocity, and may, before he can veer, engage his bowſprit in the main ſhrouds of the enemy, who pays ſhort round on her head.

THIS terrible and dangerous ſituation is infinitely to be dreaded; and it is of the higheſt importance to pay the ſtricteſt attention to

your own manœuvres and to the movements of your opponent, which you are to endeavour always to foresee and avoid as much as possible: for, on that alone, depends the success of all the manœuvres you have to execute.

REMARKS.

It is not difficult to conceive, that if you wish to board a ship, and to engage the enemy's bowsprit in your main shrouds, you have only to get a little to windward of her, and about one or two ships lengths a-head, more or less, as (from the knowledge you have of the celerity of your ship's movements) you judge may be sufficient; then brace sharp a-back your head-sails, and shiver the after ones, or lay them flat to the mast, by bracing them perpendicular to the keel *with the helm a-lee.* This manœuvre, well executed, and covered by a steady and brisk fire, will very seldom fail; but care must be taken not to veer too soon, and to come very close to your adversary; because, if you should not be a-head enough of him, you might very well miss your boarding by paying too short round him, and you would infallibly get your bowsprit foul of his fore shrouds, which would be very much to your disadvantage.

If too far a-head, the design of boarding will be again frustrated, because you cannot then avoid passing under the bowsprit of the enemy, who is however thereby exposed to receive from you at his head a good raking, as you pass athwart his fore foot, if he does not manœuver in the same manner and with equal swiftness as the assailer, who has the great advantage of priority in this transaction.

I say it is absolutely necessary to range very close to the ship whose bowsprit you wish to engage in your rigging; because, if you attempted to execute this manœuvre at a ship's length large only and to windward of your opponent, he had only, the instant he perceives your design (and if he does not choose to act in the same manner as you do), to put the helm hard a-lee and heave in stays.

ſtays. If this evolution is properly executed, the two ſhips can but range very near each other and exchange their broadſides, and the lee ſhip will immediately gain the wind of her adverſary. Therefore, to execute properly and to a certainty this manœuvre, the veſſels muſt be nearly yard-arm and yard-arm.

If the boarder be at a certain diſtance aft on the weather quarter, the ſhip endeavouring to avoid boarding muſt take care to heave in ſtays, as ſoon as ſhe obſerves the other veſſel in the act of veering, in order to cloſe her to leeward. By this manœuvre they are head to head, and ſtem ſeemingly for each other, ſo that they have an opportunity of firing reciprocally their broadſides to advantage in paſſing on oppoſite directions, and the lee ſhip will get the weather gage of his enemy.

ARTICLE III.

To board with the wind large.

If two ſhips engage with the wind large, the veſſel inclined to board ſhould keep as cloſe as poſſible on the lee quarter of the ſhip ſhe means to attack, that ſhe may execute this deſign, as has been ſhewn before, by coming rapidly to the wind, and taking very great care not to paſs a-head of her opponent.

The weather ſhip, to avoid being boarded, muſt manœuver as directed in Art. II. according to circumſtances, or the deſign of the commanding officer.

A ship may alſo be boarded on the weather ſide, by conforming to what has been ſaid of boarding to windward.

When two veſſels are in action with the wind right aft, the ſhip deſirous of boarding ought to drop a-ſtern of the enemy, in order to run up cloſe along-ſide of him, if ſhe (the boarder) has the advantage of ſailing; for as ſhe advances towards her retreating adverſary, this has nothing in her power but to range rapidly to the wind on the other tack, as ſoon as the bowſprit of the aſſailant is a-breaſt of her

her ſtern, and gain the wind of him, in order to be in a ſituation to extricate herſelf with greater facility by a good manœuvre.

I SAY the ſhip inclined to evade boarding ſhould let her opponent come a-breaſt of her ſtern: becauſe, if ſhe were hauled to the wind ſooner, experience ſhews, and it is demonſtrated, that the ſhip a-ſtern (were ſhe at a ſmall diſtance) would board her perfectly well, even if they ſail equally ſwift, ſince the aggreſſor would be to windward, and run large longer than the other, in ranging more ſlowly to the wind, and continuing to ſtem a-head of the flying ſhip. What makes this more evident is, that the boarder coming from windward preſerves longer his velocity, and never trims his ſails but as the ſhip comes to the wind, and cuts the courſe of his adverſary with a line leſs curved than that deſcribed by the retreating ſhip.

IF, by coming too ſoon, or too faſt, to the wind, the boarder choſe to abandon his enterprize, he might do it in veering a little on the other tack, and leſſening his ſail: in which caſe the retreating ſhip will not fail ſhewing her ſtern, and the boarder has it immediately in his power to rake his opponent in paſſing under his ſtern, if he hauls to the wind.

WHEN you attack a ſhip cloſely to leeward, you may keep away a little, when you are a-breaſt of her, to make it appear as if you yielded under her fire. Then, if the oppoſing ſhip be dupe enough to give credit to your movement, and to veer without caution, with intent to keep you more under her guns, you have only to heave rapidly to the wind, by putting the helm a-lee, trimming all ſharp abaft, and ſuppreſſing the effect of the head-ſails; all of which is to be done in the ſame inſtant you perceive the enemy bears down upon you. The promptneſs of this manœuvre, and the priority of the movement you gain thus unexpectedly on your enemy, will ſoon cloſe the two ſhips; and, if proper attention be paid, and the diſtance judiciouſly meaſured, it may very probably happen that the enemy's

enemy's bowſprit will be engaged in your fore or main rigging; which would be the moſt advantageous thing which could happen to you in your attempt to board: but much confidence is not always to be put in this, as you do not every day fall in with people ſo liable to be duped: it may even happen that it will no longer be in your power to board, if the weather ſhip, inſtead of bearing away, plied to windward more and more; for, this feint manœuvre may bring you ſufficiently far off to leeward of your adverſary. If you ſhould happen to be a ſhip's length to leeward, and about the ſame diſtance a-head of the veſſel with which you are engaged, you may, under cover of a ſteady and well-directed fire, heave in ſtays. By this manœuvre you come right athwart the enemy's hawſe, rake him fore and aft, and board him, his bowſprit being right over your gangway: and, let him do what he will, he never can avoid your broadſide; for, if he heave all a-back and make a-ſtern board, which is his only reſource, he may undoubtedly avoid being boarded, but will nevertheleſs be in a very bad ſituation.

ARTICLE IV.

Boarding at an anchor.

If it be intended to board a ſhip which is at an anchor, riding head to wind, the manœuvre muſt be executed under ſail; for if you cannot approach the enemy but by hauling yourſelf to head, you will never be able to board her againſt her will; ſince it will always be in her power to annoy the boats which are laying out the tow-lines. It is therefore diſadvantageous to attempt boarding a veſſel at her anchor, unleſs you are under way. To perform this with ſucceſs, you muſt be ſufficiently to windward to approach her by a little falling-off, without expoſing your ſtern to her fire, which ſhe could play on you with great advantage in this ſituation. Suppoſing therefore the boarder to be in ſuch a proper poſition to wind-

ward,

ward, as to be able to approach his opponent at anchor, the assailant in this case ought to stop his head-way by taking a-back his mizen top-sail and fore stay-sail, and, when he is come about a ship's length a-head of the vessel he means to board, let go an anchor; then manœuver in such a manner that, as soon as the mizen top-sail is taken a-back, the mizen close aft, the top-sails clued up, and the fore-top-mast stay-sail hauled down, he may come head to wind, and veer away cable till, by falling off, he comes board and board with his opponent, who is still riding at her moorings, and who at that instant ought also to be raked by the boarder.

WHOEVER shall have read our next Chapter, on anchoring, will easily conceive that the ship inclined to board has no other way of manœuvering but that just mentioned; because, as soon as the anchor is gone, the ship acquires stern-way, and when the cable is checked she comes head to wind, in which she is greatly assisted by the mizen and mizen top-sail, which impel her stern to leeward (nn. 40. & 44.) till the wind is right in the direction of the keel; and as you ought to have veered away the cable till you are exactly along-side the ship at anchor, and your own anchor is right a-head of the vessel you mean to board, it follows that, as soon as your ship comes to be head to wind, she is in a proper situation to throw her grapnels, and send her crew on board of the other, if they are the strongest.

THE ship at anchor should never wait for the enemy in that situation, as it is always a very disadvantageous one, and there is always a much greater probability of getting clear under way, provided your ship be tolerably good, and you know how to work her. But, if, for some unforeseen cause, you are obliged to continue at your anchors, you are to take advantage of the moment when the ship which attacks lets go her anchor, to cut the cable by which you ride. By this manœuvre you fall athwart, rake your adversary, avoid

avoid being boarded, and bring up with your lee anchor. Befides, if time will admit before the attack, it will not be improper to caft two fprings out, one on each fide of the cable by which the veffel rides, if you have not had time before to lay out two anchors, in order not to be furprifed, in cafe the fhip which attacks has it in her power to pafs on either fide of you: and, when you perceive for which fide fhe is determined, you heave on the fpring which is on the fame fide fhe has let go her anchor if fhe be a-head, and on the oppofite if fhe be a-ftern, veering at the fame time on the other fpring and cable, till you bring the affailant right a-breaft of you. Then, you may rake him at pleafure; as he has no way of getting out of this dangerous fituation but by preventing it, *if he can; as he has a fpring alfo, and may, under cover of a brifk fire, veer upon that fpring and cable, and lay the enemy handfomely on board.* If he has neglected this precaution, he muft cut his cable, and drop on board of the fhip to leeward; who, on the other hand, has no way to avoid being boarded, but by cutting, to get under way, or to run on fhore.

It is always eafy to board a fhip at anchor, when the wind will allow you to approach her under fail; and the beft way to proceed, is to run her along-fide, or to bring-to to windward of the fhip you wifh to attack; and, keeping her exactly to leeward of you, drift on board of her, by manœuvering your fails in fuch a manner, as to keep, as much as poffible, your broadfide oppofite to that of the adverfe fhip, in order to keep annoying her with your guns till you can clofe her, and that your conftant cannonading may prevent her fire being fo well ferved as it might otherwife be. This manœuvre is, in my opinion, the beft which can be executed in fuch a cafe as this.

When you are under way, and purpofe to board a veffel moored, care muft be taken to let go an anchor at the time of boarding: for, if the fhip attacked fhould at this moment cut her cables to

drive on ſhore, you would by this means prevent your running a-ground together*.

CHAPTER X.

On coming to an anchor.

As ſhips are often obliged to anchor with any kind of winds and weather, in ports and places of infinite diverſity, with reſpect to their ſituation and extent, I ſhall here produce the ſolution of a few problems relative to various circumſtances which moſt generally occur; laying down as a firſt principle that a ſhip ought never to come to an anchor unleſs under an eaſy ſail, that is to ſay, generally under the three top-ſails and fore-top-maſt ſtay-ſail, and ſometimes the mizen, according as the veſſel has more or leſs inclination to fall off, or come to the wind. There are, no doubt, caſes in which you may have occaſion to keep more ſail ſet; and theſe are exceptions to the principle, which are to be admitted as ſuch, without deſtroying the ſolidity of the ſame principle which remains, however, no leſs founded; becauſe, a great deal of ſail ſet is always embarraſſing, ſhould your ſhip's crew be ever ſo numerous. Very ſeldom, therefore, is anchoring attempted with all the ſails ſet (unleſs it cannot poſſibly be avoided), as the velocity of the ſhip's movements renders that manœuvre very difficult, and demands the utmoſt attention: beſides, you may happen not to have ſufficient room to ſtop the veſſel's head-way; in which caſe, you would run the

* All which has been ſaid in this Chapter about Boarding is hardly practicable but in ſmall ſhips, and ought never to be attempted without a known and evident ſuperiority of number. The moſt ſtrict attention is to be paid alſo to the ſwell of the ſea; as otherwiſe, from a mutual ſhock, the two veſſels might be in danger of ſinking. There are, however, to be found in this very Chapter many good manœuvres for ſingle ſhips of any ſize (without boarding) which, in all probability (were the caſe doubtful), might turn the ſcale of battle.

the riſk of getting foul of the anchor, by running over it; a circumſtance which would prevent it from catching and holding faſt, and requires therefore the greateſt attention in bringing up.

It is farther neceſſary, in manœuvering to come to an anchor, to take care not to drop to leeward of the place in which you mean to bring up; becauſe you would then be obliged to do it as you could, in the ſame ſituation, good or bad, in which you would find yourſelf, and very often to caſt two anchors at once, for fear of dropping ſtill more to leeward.

ARTICLE I.

PROBLEM.

To anchor in fine weather, in a place where you are to ride head to wind, the ſhip being cloſe hauled.

SOLUTION.

Being cloſe hauled under the three top-ſails, fore-top-maſt ſtay-ſail, and mizen, ſtand on until you are within two ſhips lengths (more or leſs, according to the qualities of the veſſel) of the place in which you mean to drop your anchor; then put the helm a-lee, and haul down the fore-top-maſt ſtay-ſail. As ſoon as the top-ſails ſhiver, clue them up briſkly in looſening them before you lower them; lay the mizen top-ſail to the maſt, and haul aft the mizen ſheet, the inſtant the ſhip begins to heave ſtern-way, with the wind being a-head. Then is the time to ſhift the helm from leeward to windward, and let go the anchor, veering away the cable to give it time to ſettle in the ground, or until the veſſel falls off, when ſhe is to be checked, in order to bring her head to the wind. When that is done, you right the helm, and brail up the mizen, to complete the evolution.

DEMONSTRATION.

The ſhip is heaved up in the wind by hauling down the fore-top-maſt ſtay-ſail (n. 31.), when nearly two ſhips lengths from the

ſpot you mean to drop your anchor in, becauſe the ſhip's head-way is ſufficient to ſhoot her that diſtance; and as by this movement the ſhip generally ſtops a little to windward of the place where you mean to bring up, you wait till ſhe begins to go a-ſtern a little before you let go the anchor, and the helm is at the ſame time ſhifted hard over the other way (n. 58.), to moderate the ſhip's falling off when ſhe is head to the wind. The top-ſails are clued up as ſoon as they begin to ſhiver, not only becauſe it can at that time be done more eaſily, ſince they come in of themſelves as they lower; but becauſe, if they were delayed longer, the ſtern-way would become too rapid (ſince the ſails would be all a-back), and would quickly drive the ſhip to leeward of her intended anchorage. Beſides, the celerity of her falling off would be ſuch, as to cauſe her to drag the anchor before it could have had time to get a proper hold of the ground; a reaſon why the cable is veered away, in order to give the anchor time to ſink into the bottom by its weight. The mizen top-ſail is braced perpendicular to the keel; becauſe, in that ſituation, the ſhip is impelled (n. 36.) a-ſtern exactly in the tendance of her keel. The mizen ſheet is hauled flat aft, to bring the ſhip's head ſooner to the wind (n. 40.); and, as ſoon as ſhe arrives at that point, that ſail ſhivers; in which caſe it is immediately brailed up, as being no longer of uſe. The helm is righted, as having no longer any power; ſince the veſſel is now brought up, and all the ſails are furled, except the mizen top-ſail, which is flat a-back on the maſt, to keep the ſhip ſteady at her anchor. All being ſo, the problem is reſolved.

REMARKS.

If you were to run for any anchoring-place with the wind large, whether on the beam, or more aft, your manœuvre would be ſtill the ſame, only hauling up a little ſooner to keep to windward, becauſe it is always in your power to drift as much as you think it requiſite, and becauſe the ſhip will be entirely ſtopped as ſoon as all

all her ſails begin to catch a-back, and you will have done cluing them up when they begin to ſhake. The mizen top-ſail is next to be heaved to the maſt, the helm put a-weather (n. 58.), and the anchor let go, as ſoon as the head-way ceaſes: then, after giving her a ſufficiency of cable, bring the ſhip up. It is evident that, as ſhe has been going large, ſhe will not range preciſely head to wind, ſince her head-way ceaſes as ſoon as the ſails are taken a-back, and the effort of the wind acts on the hull and rigging of the ſhip to impel her both a-ſtern, and to leeward, which is in fact augmenting the effect of the rudder, as the helm is a-weather to bring the veſſel to the wind (n. 58.): but, as the power of the wind is very great to pay the ſhip's head off, it balances wholly or partly the effort of the rudder (according as the ſhip goes a-ſtern with more or leſs velocity) and that of the mizen: thus ſhe drifts, and remains as it were lying-to with all her ſails a-back. It is the reaſon why we keep a little to windward, and let go the anchor, to bring the ſhip head to wind when the moment is come, which ſhe will obey rapidly, being withheld only forward by the cable, while the wind on her ſide forces her to leeward.

If you are obliged to ride with the head to the ſtream, you muſt, when it comes from to windward, put the helm a-lee in ſetting the mizen, then clue up all the ſails; and, when the ſhip's head is right in the direction of the ſtream, let go the anchor (provided you find ſhe has quite loſt her head-way); for, elſe, you would get foul of the anchor-ſtock by running over it. This is an attention you muſt never neglect, in all caſes, unleſs you find yourſelf under the neceſſity to bring up in any ſituation in which you may happen to be, which is almoſt always the caſe when you are taken too ſhort and too ſuddenly to have time to ſtop the veſſel: a reaſon why there is often a neceſſity of caſting a ſecond anchor, which generally catches ground by the aſſiſtance of the firſt, which has began to diminiſh the velocity of the ſhip; and as many of the ſails are to be hauled down as you can, and as quick as poſſible.

In a caſe when the current would come from to leeward, you muſt keep the ſhip away till her head comes to the ſet of the ſtream, and take in all the ſails, to diminiſh with all poſſible ſpeed her head-way, which always continues of itſelf long enough when the wind is aft or very large; and when the ſhip is ſtopped by the effort of the water, let go the anchor without (if the current is rapid) waiting for the veſſel gathering ſtern-way; and, in this caſe, as well as all thoſe wherein there is a ſea, or blowing freſh, the ſhip requires a great deal of cable.

If you come to an anchor when it blows ſo freſh as to oblige you to reef your top-ſails, you ſtill act as above directed, taking great care to foreſee the velocity of the ſhip's movements, and paying more attention to the manœuvre, which now becomes more difficult, every thing growing more unhandy as the wind freſhens; becauſe the ſhip has got a ſtronger head-way, and that it is often too late that we attempt to repair the fault of a bad manœuvering. It is in ſuch ſituations, and in all thoſe which are critical, that we diſcover the ſuperior ſeaman; who lets nothing eſcape, which can poſſibly contribute to the ſpeedy execution and ſucceſs of the manœuvre intended to be made.

ARTICLE II.

PROBLEM.

To come to an anchor with the wind aft.

SOLUTION.

You muſt begin firſt by handing the main top-ſail, and then lowering the fore top-ſail down on the cap; and, when you are within a reaſonable diſtance of the place where you mean to drop your anchor (which diſtance is to be computed and judged from the readineſs of the ſhip in obeying the helm, and its velocity), the tiller may be put either one way or the other (n. 50.), the fore top-ſail and fore-top-maſt ſtay-ſail clued up and taken in, the mizen top-ſail

top-ſail braced ſharp up, and the mizen ſheet hauled flat aft. When the ſhip has ranged cloſe to the wind, ſhe is as it were lying-to under the mizen and mizen top-ſails, with the laſt-mentioned ſail full, or a-back, according as you may have occaſion to ſhoot a-head or drop a-ſtern; ſo that, if you are too much to windward of the ſpot where you mean to bring to, you drift till you arrive at it: if you are preciſely in the birth wiſhed for, you let go the anchor in lowering down the mizen top-ſail, which is to be furled as ſoon as the veſſel is brought up; then the ſhip will come head to wind by the power of the mizen, which muſt be brailed up as ſoon as it ſhakes.

DEMONSTRATION.

THE main top-ſail is taken in, and the fore top-ſail lowered down, to diminiſh the great velocity which a ſhip commonly has when the wind is aft, in order to eſtimate the diſtance with greater preciſion, and to have her movements under a greater facility of command. When you think yourſelf at the neceſſary diſtance the ſhip requires to ſtop cloſe hauled, at the place you wiſh to anchor, you put the helm on board one way or the other (n. 50.); you brace ſharp the mizen top-ſail for the tack you haul upon (n. 41.), and haul the mizen out to bring the ſhip rapidly to the wind (n. 40).

IN the ſame moment, the fore top-ſail is to be clued up and handed, and the fore-top-maſt ſtay-ſail hauled down, becauſe they oppoſe the movement of the ſhip as (nn. 31, 32, & 33.) ſhe is coming to. When you are cloſe to the wind, the anchor is let go, if you are in the birth you wiſh. If too far ſtill to windward, you can drift, keeping the mizen top-ſail full; and, when you are to windward, ſhould you find yourſelf too far a-head, you have only to lay the mizen top-ſail a-back to go a-ſtern (n. 44.), putting at the ſame time the helm a-weather (n. 58). When the veſſel has drifted ſufficiently, let go the anchor, and furl the mizen top-ſail;

becauſe

because the cable might be fatigued, ſhould it come to blow freſh; then the ſhip will ſoon range head to wind, though the mizen be ſtill out (n. 40.); and, when that point is attained, the mizen is brailed up to prevent the ſhip ſheering; and the helm is righted for the ſame reaſon.

THE ſhip being at anchor without ſails, and without motion, the problem is ſolved.

REMARK.

THERE are certain circumſtances in which you are obliged to come to an anchor with the wind aſt, ſtanding end on, becauſe there is not always the ſpace neceſſary to deaden the ſhip's way. In this predicament the ſails are to be taken in as ſoon as poſſible, in order to leſſen the great impetuoſity of the ſhip's head-way.

WHEN you are come to your birth, the anchor is to be let go, and the cable veered away plentifully, that the anchor may have time to ſink in the ground; then begin to check her gently, veering ſtill more cable in proportion as the ring-ropes or ſtoppers, you are to have placed on it before-hand, ſnap; for they are to be made of a ſnapping quality, that, by attempting to bring the veſſel up at once, you may not be expoſed to drag your anchor.

OBSERVATION.

A GENERAL RULE.—When the wind is not violent, the top-ſails ought always to be clued up at the maſt-heads; that is to ſay, the ſheets muſt be let go, the clue-lines and bunt-lines hauled cloſe up and above the top; then lower away the top-ſails roundly, ſtill hauling on the cluelines and buntlines to keep them cloſe up, and haul through the ſlack of the braces as the yards come down; ſo that the ſails, when on the cap, are found ready furled and well.

THIS method of taking in the top-ſails is the moſt expeditious, and does not expoſe them, when the wind is not abſolutely ſtrong, ſo as to oblige you to ſtrike them down a-portoiſe: and, in manœu-

vering

vering in this manner, you run leſs riſk of ſplitting or tearing the ſails than by any other method.

ARTICLE III.

PROBLEM.

Scudding under a fore-ſail to come to an anchor.

SOLUTION.

WHEN obliged, by ſtreſs of weather, to run under a fore-ſail only and come to an anchor, you muſt take it in before-hand, and, the reſt of the way, run under bare poles*. When you are come to the neceſſary diſtance to ſheer to the wind, you execute it by putting the helm hard a-lee: and, as ſoon as the ſhip is come to, let go the anchor. In this caſe, ſhe will require a great ſcope of cable, and to be checked handſomely, with ſnapping ring-ropes put on before-hand, in order to make her ride head to wind: as ſtopping her at firſt too ſhort might very well endanger her cable or anchor. Should the firſt not bring her up, a ſecond muſt be let go.

DEMONSTRATION.

As you cannot run for an anchorage under a fore-ſail, unleſs before the wind, or very free, you are neceſſarily obliged to furl that ſail at a great diſtance; becauſe, in that poſition, the velocity of the ſhip will, by the violence of the wind, be but too much kept up, ſo as to make you run the reſt of the way, which may perhaps be a quarter or half a league, under bare poles, the wind being

* During this interval, the lower yards and top-maſts are to be ſtruck: long ranges bitted of the two bower cables are to be got upon deck: the neceſſary quantity of water by the bitts, ſtoppers of every kind and ring-ropes are to be ready for ſervice in their proper places: the ſheet anchor is now ſuppoſed to be over the ſide clear for letting go.

being nearly aft. If you were obliged to run at that distance close hauled, you would never reach your birth, should the fore-sail even be set; because, as was shewn before, the ship would be laid-to. You put your helm over to sheer to windward when you think you are at the necessary distance, that you may have time to deaden the ship's head-way: and as, when she stops coming to, her head-way ceases, you let go the anchor, and veer away a great extent of cable; because, when it blows hard, there is commonly a great swell, and the pitching motion it gives to the ship, joined to the effort of the wind on the whole machine, would bring home the anchor. It is therefore absolutely necessary to veer away a great length of cable, to give the anchor time to settle, and to cause the cable to make a very acute angle with the ground, that the strain may be more perpendicular on the flukes of the anchor which is buried in the sand.

ARTICLE IV.

PROBLEM.

To anchor with a spring, in order to present the vessel's side suddenly to a place or ship you wish to cannonade.

SOLUTION DEMONSTRATED.

THIS manœuvre is executed when you know that the wind or current will bring your head, when at anchor, towards the object you mean to attack: for, should the wind or tide bring your broad-side to bear on the object you mean to cannonade, the spring would be but a mere precaution, to get under way with greater alertness, in case you were so handled as to be obliged to retreat; or in case the wind or tide should shift.

IN the first case proposed, this evolution will be executed with success, if the attacking ship cast a large snatch-block in the aftermost port, on the same side you wish to present to the wind or current, and on the same side with the anchor and cable with which you mean

mean to bring up; then, through the block, is to be reeved a hawſer, the end of which is to be carried forward and clinched to the ring of the anchor; the other part is to be brought to the after capſtern, after having firſt taken the neceſſary ranges of the cable and hawſer according to the depth of the water you are to bring up in. That done, and the ſhip being arrived at the birth, you are to deaden her way according to circumſtances: you let go the anchor, and veer away enough cable and hawſer, now a little more of the one, and then a little more of the other, according as you wiſh to preſent more head or ſtern; which you can do by heaving on the ſpring, or, what is the ſame, veering away more cable; but ſhould you find it requiſite to ſhift your poſition, you have only to veer out more of the hawſer. All this ought to be eaſily conceived, after what has been ſaid before.

END OF THE SECOND PART.

AN

ESSAY

ON

NAVAL TACTICS.

PART THE THIRD.

Various Obſervations on the Marine.

THIS Part will preſent us the Mariner intirely taken up with the care of foreſeeing, commanding, acting, regulating, and keeping every thing in order within: enabling himſelf to operate afterwards with celerity, accuracy, and no confuſion. As for what is to appear outwardly, it is the fruit of reflexion.

CHAPTER I.

Of the uniformity which ſhould be introduced among the ſeveral maſts of ſhips; of their height and ſituation.

I. THE right height to be given to the maſts of ſhips, is ſtill, for the builders, a problem which remains to be ſolved. Some contend for more, ſome for leſs. The moſt ſkilful among theſe gentlemen have not paid attention enough to the ſolutions and determinations which are contained in the Works of the late Mr, BOUGUER

Bouguer on that ſubject. It ſeems, on the contrary, as if they had made it a point to deviate, as much as poſſible, from the true principles in that reſpect, by raiſing the maſts a great deal more than they were formerly, although they were already much too high, as the learned Author I have juſt mentioned has aſſerted. An experience, confirmed by obſervations out of number repeatedly made on my ſide, has convinced me of the following truth; *viz.* that "as ſoon as a ſhip inclines, her velocity diminiſhes in the ſame ratio as her inclination increaſes." I have not been the only one who has made theſe obſervations: ſeveral officers, without any participation of mine, have verified the ſame principle on different veſſels, and at different periods of time, and in all thoſe various courſes which are termed oblique with reſpect to the direction of the wind. As I had no ſhare in thoſe various experiments, I cannot be ſuſpected of partiality: but, as they have always ſhewn to thoſe who have condeſcended to make them, that the preſent mode of maſting is generally too high, I will not heſitate a moment longer to deliver here an epitome of my own experiments on that ſubject.

Having all the ſails out, and being hurried on by a ſtrong gale, I have ordered all the top-gallants, the ſtudding, and the ſtay ſails, to be taken in, without the ſhip loſing the leaſt perceptible degree of her velocity; moreover, I have ſeen it ſometimes to increaſe by a twentieth, and that even at a time when the ſhip ran already at the rate of nine or twelve knots an hour.

These trials, which I have made with care, and had executed with celerity enough, that the wind ſhould not have time to increaſe or diminiſh in ſtrength, are ſufficient to prove the neceſſity of lowering the center of the effort of the ſails in general, and therefore all the maſts. I have repeated my experiments in augmenting the number of ſails, even at the riſk of fatiguing ſometimes the maſts themſelves; and I have always found that the velocity did not increaſe,

increaſe, when the ſhip was more inclined; but that ſhe laboured more and more in all her parts, as her movements became ſtronger and the concuſſions of her pitchings rougher, although the ſea was not more ſwelled than before. At other times, when the ſhip inclined pretty much, though the wind was not quite ſtrong enough to hurt the maſts, I have ordered the ſails to be diminiſhed; and it happened that the ſhip, after that ſuppreſſion of the top-ſails, was eaſier in her movements, ſteered better, and was more quiet, though the ſwells of the ſea were ſtill the ſame; an attention which muſt not be neglected in theſe kinds of obſervations, which cannot be too often repeated before venturing on a deciſion. However, our intention is not here to point out any diminution in the ſurface of the ſails, although we recommend a diminution in their height. On the contrary, it will often happen that we ſhall rather recommend increaſing it upon the whole. For, the loſs which is apprehended from the abating of the height, may eaſily be regained, in my opinion, by the width. There will even reſult, from that operation, another advantage: the top-ſails, by this reform, being ſhorter and, thereby, proportionally wider than the lower ſails, will be more eaſy to be ſhaped in cutting; and their ſides being formed with lines exactly ſtrait, the ſail will be the more taught, a principal quality by which it will always be found to produce a much greater effect on the ſhip. The maſts being ſhorter, and the ſails wider, with leſs fall, the ſurface will be the ſame: but the effort of that ſurface will, with the ſame wind, act on ſhorter levers, the fulcrum of which ſhall not have been altered; therefore, it will operate at a ſhorter diſtance from that fulcrum; and therefore much leſs will be the power which cauſes the ſhip to incline: and the ſhip, finding herſelf more upright, will ſteer with more velocity, becauſe her water-lines will be then more advantageous than when ſhe heels. On the other hand, the leſs the ſails are inclined, the wider is the ſurface they preſent to the wind, and the ſtronger, of courſe, the impulſion they receive from it: an advantage

advantage which cannot fail to produce an increaſe of ſwiftneſs and a decreaſe of drift. To this let it be again added, a real and important advantage, *viz.* that of trimming much better the ſails, of bracing them with more eaſe and command, and rendering the whole maſting more ſolid in general, and more capable to reſiſt in bad weather as well as in an engagement.

But, how are we to come to the determination of the right height to be allowed to the maſts in ſhips? or, which is the ſame, the right quantity they are to be ſhortened, according to the principle of their preſent conſtruction? The *Treatiſes on the Art of finding the perfect point for the maſting and manœuvering of ſhips, by M.* Bouguer, teach us that method. It is in thoſe very Treatiſes I have imbibed the firſt notions of my principles on that ſubject. But, in order to give an anticipated idea of that curious inquiry, and to engage the builders and ſeamen to bring to perfection this part both of the building and manœuvering of ſhips, from which, as much as from their bottom, moſt undoubtedly depends their ſteerage, I will mention here what M. Brue, a very learned and ſtudious Officer, made me conceive on that head: and, for the ſake of doing juſtice to his inſtruction, I will repeat his own words:

"That maſting," ſaid he, "is abſolutely perfect, when the "center of the effort of the ſails is preciſely oppoſite to, at the "ſame height as, or parallel with, the *point-velique*. Now, what "is the *point-velique?* is the queſtion. The *point-velique* is that "where a perpendicular, raiſed from the center of gravity of the "floating line of a ſhip, comes, in a direct courſe, to be interſected "by the direction of the abſolute impulſe of the ſea on the prow "of the veſſel."

It is clear; there is no need of any great effort of imagination to conceive this principle. As for my part, I find it ſo ſelf-evident, that I wonder how thoſe who make it their profeſſional buſineſs to build ſhips, have not yet made uſe of it. For, this *point* once known, it is certain that of the center of effort of the ſails will be

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ſo too; and their right height, as well as that of the maſts, muſt follow of courſe, and be determined. A little more calculation, I confeſs, will be required, as well as attention, on the plan of the ſhip, in order to find out that determination of the direction abſolute of the effort of the impulſion of the water on the prow. But, it muſt not deter us from purſuing it. On the contrary, it ſhould, I think, be an additional inducement for thoſe who, building ſuch good veſſels as we are now poſſeſſed of, and as might ſtill be of a more advantageous form, will be deſirous to make them ſtill more perfect, in maſting them in a more advantageous manner. And this would undoubtedly be the caſe; as I could mention ſeveral veſſels, the cutting ſhorter of whoſe maſts has been attended with the greateſt ſucceſs. Theſe facts, which could be atteſted by many able ſeamen, will always ſpeak highly in behalf of this principle; although, when that ſhortening was made, they miſſed having the attention of widening the ſails in proportion, in order that they might gain that way what ſurface they had loſt by the lowering of their heads.

"But," continues M. Brue, "in carrying this inquiry farther "than it ever was, we find that the interſection of the two above-"mentioned lines, *viz.* that of the impulſe abſolute of the water on "the prow, and that of the perpendicular at the center of gravity of "the ſurface of the floating line of the ſhip, cannot take place unleſs "in a direct courſe; and that, as ſoon as the courſe becomes oblique, "they no longer meet. The center of gravity of the floating line's "ſurface of the ſhip paſſes to the leeward of its axis, on account of "the proportional inclination which always is the neceſſary conſe-"quence of that ſort of courſe; and the direction of the ſhock of the "fluid, which then takes its origin a little to leeward alſo of the prow, "paſſes in its prolongation to windward without meeting the per-"pendicular at the center of gravity of the floating line's ſurface," (a circumſtance not difficult to conceive, if we endeavour to repreſent to our imagination the horizontal edge of that floating line's ſurface

face but ever ſo little inclined); " whence it reſults that no *point-velique* could be found in any courſe but a direct one: which is " true; unleſs the imagination could fancy ſuch a ſhip as would " neither drive nor incline in an oblique courſe: but none of that " kind can, or ever will, be found; hence no perfect mode of maſting could be diſcovered in the laſt caſe of the oblique courſe."

THIS is true, rigorouſly ſpeaking: for, each inſtant of a courſe has its particular and different point of the prow which is ſtruck by the water; a variation which is owing to that of the ſtrength of the wind, to the pitching of the ſhip, and to the greater or ſmaller inclination which the rolling motion of the ſhip produces.

" BUT," ſays again M. BRUE, " after having given an evident " demonſtration of the laſt principle, unneceſſary to repeat here, " the *point-velique*, relative to the various circumſtances juſt mentioned which accompany the courſe of a ſhip, varies therefore in " the proportion of the almoſt infinite variety of thoſe ſame circumſtances, that is to ſay, according to all the degrees of drift, " all the degrees of inclination on either board, forward or abaft; " as many times, in ſhort, as there are new points of the prow " either ſtruck, or no longer ſtruck, by the fluid, the *point-velique* " aſcends or deſcends.

" I PASS over the minute examination I could make of each " ſingle and particular cauſe which contributes to lower that *point* " from its utmoſt height, as it were, which is in the direct courſe, " to its loweſt, which never happens but in the moſt oblique courſe, " accompanied with the greateſt lateral inclination of the ſhip: " and I ſay there is no method to get out of that common beaten " road which is purſued in determining the dimenſions of the " ſeveral maſts, but that of paying the greateſt attention to the " following conſiderations; *viz.* Such a ſhip being intended for " ſuch a latitude, the wind ſhe is moſt commonly to expect there, " will be nearly of ſuch a ſtrength, and generally oblique to her

" course by so many degrees: so that her most common drift will " be nearly so many degrees, and her lateral inclination so many, " &c; in order to give her, therefore, the most suitable masting, " or, in other words, the most perfect, relatively speaking, we must " seek for her *point-velique* in what situation we shall think most " convenient, and there place the center of effort of her sails".... Now, all this reasoning tends evidently to recommend the shortening of all the masts, and to prove the necessity of doing it, at the same time as it determines their height. The most difficult point, in that operation, will be to find out the direction of the absolute impulsion of the water on the prow, when the ship steers a course close hauled or with the wind on the beam, with such an inclination as the ship could be supposed to have in either of these two courses, and admitting also that the gale would allow to have four square-sails out, along with the mizen top-sail. Granting these two suppositions of the wind on the beam or close hauled, it will be easy to determine the height of the masts proper for that double situation; because, if the gale blows harder, one may lessen the number of sails; if weaker, one may increase it by adding stay-sails, top-gallant sails, jib, &c: if the gale strengthens, then the surface of the sails may be increased again by adding the studding and top-gallant royal sails: finally, it is very clear that top-gallant and top-gallant royal sails will always be of service when the center of the effort of the sails will be wanted to ascend.

Putting aside all the absurdity of prejudicial habit, this demonstration and our reasoning must, upon examination, appear evident, provided the opposition which the natural laziness of man must be expected to throw into the scale should also be rejected; for, there is no doubt but calculations much more prolix than difficult, and which are tedious enough, will most certainly be requisite: but, they will be attended, in the end, with real advantage; and that labour is certainly not to be regretted, which is to be followed by the

the improvement of thoſe who ſhall have condeſcended to give themſelves up to it. Beſides, however repugnant it may be to any one prejudiced againſt it, I do not imagine that prejudice can have any power againſt a truth eſtabliſhed by all that we have juſt ſaid, as well as by the experience of many able ſeamen, more diſpoſed, it is true, for making obſervations, than really learned on the ſubject, but in whom good ſenſe and truth ſpeak intelligibly enough to deſtroy that obſtinate prepoſſeſſion implanted by bad habit and cuſtom, which ſometimes operates powerfully on the minds of many, who enter into the ſea line, without the neceſſary previous information.

II. I AM going now to propoſe an idea relative to that ſubject which appears to me as reaſonable as it is well grounded: I ſay that every thing which concerns the *fore*-maſts ſhould be made in every reſpect equal to, and uniform with, the *main*-maſt. For, what can be the uſe of that difference in height, in bulk, in ſize, between the maſts and between the ſails? Of no other certainly but multiplying difficulties, of which it might be very eaſy to get rid, by rendering every thing uniform, the maſts, the tops, the yards, the ſails, the ſhrouds, the ſtays, and, in general, all the ſtanding and running rigging. In obſerving, which is very eaſy, to preſerve the center of the effort of the ſails at the ſame height as the *point-velique*, it will be impoſſible to loſe any thing of the impulſion or of the direction, ſince the ſurface will always be the ſame and diſpoſed in the ſame manner. The advantage which will be deduced from it will be, firſt, an equality in the manœuvres and in the manœuverers about the various and diſtinct parts of the ſhip: ſecondly, a great ſaving will be the reſult, if put in practice; for, the rigging and the change of any of the maſts, will ſerve for another maſt, which cannot be the caſe in the preſent ſituation of things; for, whatever is uſed forward is too weak for abaſt, and *vice verſâ*. There will be no need of different blocks, nor of ropes of different ſizes; all will

be alike. The fore-ſails and their yards will do abaft; there will be need but of a double ſet of thoſe kinds of ſtores: this uniformity will certainly be very advantageous; and its utility ſeems to me ſo ſtriking and ſo eſſential, that I cannot imagine the leaſt doubt can be entertained about it.

III. The power, or the effort, of the ſails on the ſhip ought to be diſpoſed in ſuch a manner that, being all equally trimmed and in the ſame way, they will be in equilibrium round a certain point, on the axis which is determined by the union of the direct impulſions of each of the parts of the prow equally divided into two parts by the axis of the floating line's ſurface. So that, the ſection on the axis of the directions of the effort of the fluid on each ſide of the prow in the direct courſe being known, and ſuppoſing the ſurface of the ſails a-head to be equal to that of the ſails abaft, the fore and after maſts will be reciprocally placed at an equal diſtance from that point. But, if the courſe be oblique, then it alters the caſe in a due ratio between the greateſt and the leaſt obliquity, as well as between the greateſt inclination of the ſhip and her moſt upright or horizontal ſituation. So that, in order that the maſts may, in ſuch a circumſtance, be properly placed, it is neceſſary to find out the middle direction, between the direct and the lateral efforts of the fluid on the prow in the ſuppoſed oblique courſe, and the inclination which will be conceived as being a neceſſary conſequence of it. Then, the point of ſection of the direction of that middle impulſion on the axis, coming from leeward, will be that round which it will be proper and neceſſary to place in equilibrium the effort of the ſails at the time of ſtepping the maſts, under the ſuppoſition however, as we have ſaid before, of a courſe, or of an inclination of the ſhip which ſhall be the moſt relative to the qualities wiſhed to be given her.

In order to find out afterwards the direction of the effort, or impulſion abſolute, of the prow in the oblique courſe, it is neceſ-

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ſary to know firſt the direct, the lateral, and the vertical impulſions. The two firſt will ſerve to draw a parallelogram, the diagonal of which, ſtarting from the point of union of theſe two impulſions on the exterior part of the leeward of the prow, will cut the axis of the floating line's ſurface according to the ſide of the ſhip; and that point of ſection of the diagonal, or, what is the ſame, the direction of the impulſion, which is a middle one, between the direct and the lateral with the axis, will be that where the ſet of maſts is to be placed; for, it is round that point the effort of the ſails is to be placed in equilibrium.

If, at the two extremities of the diagonal, formed by the direct and the lateral impulſions, two perpendiculars be raiſed and made ſo as to be equal to the vertical impulſion, (after having confounded and united into one and the ſame the three points of the prow's ſurface on which they act); and if, afterwards, a line be drawn along their extremities parallel to the firſt diagonal, a ſecond rectangle thereby will be obtained vertically ſituated, the diagonal of which, ſtarting from the point of union of the three impulſions on the exterior ſurface of the prow, will give the direction of the effort abſolute of the water on the prow of the ſhip: and this direction, meeting (as we ſaid before) the perpendicular in the center of gravity of the inclined floating line's ſurface, or on the horizontal one which ſtarts from it on the windward ſide, will mark, at the point of this interſection, the height of the *point-velique* for this particular oblique courſe, and conſequently the height of the center of effort of the ſails, whence the height both of the *lower* and of the *top* maſts is to be taken: for, as to the top-gallant maſts, they ought to be arbitrary, as they are but ſuppliers to the want of wind, a quality they have in common with the top-gallant royal.

CHAPTER

CHAPTER II.

Observations on the different inclinations given to the masting of ships, with respect to the water-line.

THE masts are hardly ever stepped in the same manner in every ship. That operation is again one of those which are rather submitted to custom than judgement. Some will have them perpendicular, while others chuse to have them lean forward, and others prefer to have them lean abaft. Each party bring, to the support of their opinion, reasons drawn from some experiment or other which chance has sometimes rendered specious enough to give room for their favorite error.

IN discussing these various opinions, mariners, in general, seldom care to examine whether the ships are alike, and whether what they insist upon is conformable to principles, or not. So that, while they repeat the same thing in one ship as they have already practised in another, they precisely do the contrary of what they want to execute. But, without carrying this digression any farther, let us return to our subject. In this respect, confidence must be given to the sagacity and judgement of the builder, who ought to know the qualities of his ship even before he undertakes to put her on the stocks. If one has not an opportunity of taking directly from him the necessary instructions, it is proper, however, to take notice that, if the leaning of the masts is so calculated as to be forward, the direction of the effort of the sails will be inclined towards the bottom, obliquely with the horizon; whence it results that they will make the head of the ship to plunge whenever they receive a strong impulse from the wind, which may diminish the head-way of the ship, while it increases, at the same time, the celerity of the pitching: the sails also will besides be with more difficulty trimmed, especially when circumstances shall require them to be close hauled,

since

ſince the bracing of the yards will be more confined. Therefore, the only advantage which can be drawn from this oblique maſting of ſhips, is only to render the ſhips more ready to fall off.

If the maſts are ſtepped perpendicularly, the direction of the effort of the ſails will be horizontal, always ſuppoſing the ſhip to be in an upright poſition. Therefore, this effort not being diſcompoſed, it will preſerve a much greater action, and the ſhip will ſail with the greateſt velocity ſhe is capable of.

If the maſts are leaning abaft, the ſhip will be more ready to come to the wind, becauſe the ſails will be a little more aft: theſe will alſo be more eaſy to trim ſharp on account of the braces not being ſo much confined. Now, as this poſition of the ſails will raiſe obliquely above the horizon the direction of their effort on the ſhip, it reſults that, by their power, the ſhip will find herſelf very much eaſed away from the water: for, it is moſt certain ſhe will not prolong her courſe, unleſs ſhe leans by a great deal too much; therefore, ſhe will riſe much lighter over the waves of the ſea, pitch leſs, keep better the wind, and tack quicker. Such is nearly all that can be ſaid in reſpect to practice.

CHAPTER III.

Of the cut or ſhaping of the ſails: of their tenſion, and tendency to fix themſelves perpendicularly to the direction of the wind.

I. Starting from the principle of ſhortening the maſting of ſhips by increaſing the length of the yards in general, and of courſe the extent of the ſails upon them, it will be very eaſy to cut the top-ſails; as thereby their ſides will no longer be formed of any other but ſtrait lines. The courſes, or lower ſails, will alſo have the ſame advantage. But, ſometimes (though as ſeldom as poſſible) it will be found neceſſary to cut them ſo, that the foot of the ſail ſhould be narrower than the head or ſquare ſide, in order that they

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may be made more taught in trimming. (This mode of shaping them, for example, will always be requisite whenever it is possible to place their chess-trees perpendicularly, and to tack the clues of the fore-sail on the forecastle instead of placing it on the knee of the head or cutwater, under the extremities of the lower yards.) The top-gallant, as well as the top-sails, will have nearly the form of a square, as their shape will be that of a trapezoid, the parallel sides of which will be almost equal. But, in giving the dimensions for the top and the top-gallant yards, it will be proper to order the arms and ends, where the cleats are made for the reefs, longer than they usually are; and to mark on it each cleat so that a perpendicular line, which would be drawn from the yard-arm at one of the cleats, should correspond to the tabling of its own reef. By these means it is evident as many such cleats shall be requisite at the end of each yard-arm (besides that used for the bending of the sail to it) as there will be reefs to the sails. The reefs also ought to be marked, and the reef-bands placed gradually. Thus, when the last reef is taken in, it is necessary, and it will so happen, that the top-sail will not be hoisted more than a foot or two above the cap of the mast, that the sail may be diminished by, at least, one half, or two thirds of it: which manœuvre must be comprised in three reefs for the top-sails, and in one for the top-gallant, to which I should like to have some put likewise, in order to make a more advantageous use of them when, in a strong gale, one is obliged to carry them hauled lower down.

THE stay-sails ought, generally, to be triangularly shaped, and set in such a manner that they should not obstruct the other sails; as their use has been introduced only to fill up the vacancies in a close-hauled sailing. They are to be trimmed in such a manner, that no wind should be able to pass between the masts without meeting some canvass in its way. I have seen a top-stay-sail trapezoidly shaped, which had two fixed clues; the one on the edge of the

fore-

fore-top, between the two after treſſel-trees; the other upon a ſtrop a little above the frame of the fore-bell: ſo that nothing obſtructed the fore-ſail between the fore-maſt and the ſtay which came from the top to the bell. But, the foot tack of ſuch a ſail ought to be made moveable, that it may be trimmed ſharp when wanted.

THE top and top-gallant ſtudding-ſails ought always to be triangularly ſhaped, that they may be eaſily manœuvered, and that they ſhould not obſtruct the top nor top-gallant ſails. When they are thus ſhaped, it will be proper to haul out their tacks before hoiſting of them; then, their haliards paſſing over the fore part of the top-ſail, you will hoiſt them behind that ſail. When you want to haul them down, you have but to looſen the haliard, weigh upon the down-haul tackle, which, like the haliard, is fixed to the head of the ſail, and is to go through a block placed towards the middle of the fore-yard at the diſtance of the fall of the outſide part of the ſtudding-ſail: then, with a piece of rope-band, you will furl the remains of the canvaſs on the end of the lower yard.

THE lower ſtudding-ſails will moſt generally be of the parallelogram ſhape; and, for the ſake of their being more eaſily manœuvered in changes of winds, it will be proper to trim them on booms made with hooks.

AFTER the ſails ſhall have been thus cut and completely made, it will be proper, the firſt time you put to ſea, to employ them for a week or a fortnight, in order to work them and make them ſtretch as much as the cloth, as well as head, leech and foot ropes, which are all new, will permit; then, taking them out, you will replace them with others to the ſame purpoſe, and ſhape them a-new, in order to make them, laſtly, as little concave as poſſible; for, it muſt be taken for granted that a ſail can never, at the firſt ſtroke, be cut to its proper and true form and ſhape, becauſe it always ſtretches as it wears.

II. It requires one to have but common eye-ſight to be convinced that ſails are never perfectly flat. But, every one is not perſuaded that the more extended is the ſail, the greater is the impulſion it receives from the wind which ſtrikes it perpendicularly, and the more effectually, of courſe, the ſail will afterwards act on the veſſel. It is a matter of aſtoniſhment to me how ſo many ſeamen are ſtill of opinion that a bag muſt be left at the foot of the ſail, to lodge the wind in; and how, to ſuch as propoſe to them objections againſt that cuſtom, they give for the only reaſon, that it is the feather which carries the bird off. This reaſoning is abſurd. A hauled-down top-ſail has got as much diſplayed cloth in it as when hoiſted up and well extended. In that ſituation, it forms by its convexity a very conſiderable kind of bag in which the wind may play at eaſe; and, notwithſtanding, it is obſerved that the rapidity of the ſailing decreaſes very much; whence we are to conclude that the power of the wind muſt have ſtrongly diminiſhed, ſince the ſail produces no longer the ſame effect upon the veſſel. Now, if you wiſh to enter into further particulars, and know demonſtratively the cauſe of that diminution in the impulſe of the wind, you have only to pay attention to the air which acts againſt the foot and the head of the ſail; and you will ſee that the wind, which ſtrikes at the head part, makes an effort to re-act towards the foot in the ſame manner as and againſt that which, having ſtruck at the ſame inſtant at the foot, endeavours to re-act towards the head. From this ſhock reſults (though the air eſcapes at each ſide) a compreſſion in the ſail. But, after having acted inwardly in the ſame manner as if it were ſhut up, it happens that it finds itſelf more and more compreſſed by that which ſucceeds to the firſt; and, though it eſcapes by the ſides, it is evident that it tries to extend, and that it impels conſequently, with an equal power, all the parts of the ſail perpendicularly; which is the cauſe of the ſail aſſuming the form of a circle's arc. Therefore, the ſail will produce no greater

greater effect than if it had no other height but the ſpace contained between the two yards which ſerve to trim it: and I ſay that, rigorouſly ſpeaking, it may even not have that whole effect; for, that ſort of whirlwind, which is procured in the center by the re-action of the wind which ſtrikes its upper and lower parts at the ſame time, cannot fail diminiſhing the ſhock of the parts which, ſucceeding the former, would have ſtruck the ſail with all their primitive power; while, on the contrary, this power is now almoſt intirely deſtroyed by this barrier which oppoſes for a while their paſſage. To all theſe reaſons may ſtill be added, as a further argument, that the ſail having the form of an arc, there can be but very little wind capable to ſtrike it perpendicularly; for which very ſtrong reaſon it muſt, of courſe, have much leſs effect than another ſail, of the ſame height and width, which ſhould be very exactly ſpread every way.

I HOPE I have ſaid enough on this ſubject to obviate the oppoſite prejudice, and to engage every reaſonable ſeaman to direct his attention to the ſails of his ſhip, that they may be cut in ſuch a form as to preſent as flat a ſurface as poſſible.

III. THE center of effort of the impulſe of the wind, on the ſails expoſed perpendicularly to the courſe of the wind, anſwers exactly to the center of gravity of the ſurface which is ſtruck in that direct ſituation. But, as ſoon as you preſent it obliquely to the courſe of the fluid, and keep it ſo to it, the center of effort of the total impulſe will paſs on the weather ſide of its center of gravity; becauſe the particles of air, which at firſt met the ſurface, have been re-acted, and by the very act of their re-action they ſtop part of the paſſage to the ſucceeding ones, which diminiſhes of courſe both the ſtrength of the ſhock and the impulſe they would have given to the ſail, had not their movement been interrupted. But, this deviation of re-action in the firſt particles of air which have ſtruck, is repeated afterwards. For, all thoſe which ſucceed

them during the whole time the ſurface is kept obliquely to windward, continue to re-act to leeward: ſo that, from the firſt vertical line (taken from the ſource of the wind) out of all thoſe which form together the ſurface, there is a continual ſeries of obſtacles which change the ſhock of immediate and ſucceeding particles, and which alters it ſo much the more as they are to ſtrike the parts moſt to leeward of the ſail, and ſo much the leſs as they will ſtrike thoſe which are moſt to windward. Therefore, the leeward ſide of ſuch ſails as are obliquely expoſed to the wind is always leſs ſtruck than that which ſtands to windward. Hence it reſults that the center of effort of the abſolute impulſe of the wind on the ſail, is lodged in that weather-part of the ſail which is ſuppoſed to be equally divided in two, ſince that is the part which receives more impulſion. Therefore the ſame center of effort is alſo to the windward of the center of gravity of the ſurface; and the act of its removing from it towards the wind keeps pace with both the impulſe received by the weather ſide of the ſail, and that received by the lee ſide of the ſame ſail, and is in the ſame ratio. The truth of this aſſertion is continually demonſtrated by daily experience of ſhips at ſea. The ſails are carried by the yards and by the maſts, which divide them perpendicularly into two equal parts, from top to bottom, through their center of gravity, ſince they are of a trapezoid ſhape. When, being placed obliquely to the wind, they are left at liberty, without being confined by their arms or bowlines, they immediately range themſelves perpendicularly to the courſe of the wind, becauſe their weather ſide receives more impulſion than the lee ſide; and there they remain conſtantly, unleſs they are compelled to alter their poſition, becauſe all their parts are ſtruck equally, which keeps an equilibrium always among them; for, the power of the wind, whether it increaſes or decreaſes, acts always the ſame on them all.

THIS proof, which eſtabliſhes a wide difference to be made between the center of gravity and the center of effort in the ſails,

requires

requires that a great deal of attention ſhould be paid to the uſe of that knowledge in the practice. For example, ſome ſort of cleats might be fixed in the middle and on the after part of the yards, which, in oblique courſes, puſhing them to leeward, would eaſe them out of the ſhrouds, and facilitate their bracing in carrying their center of gravity, as well as the center of the abſolute effort, to leeward; which operation would of courſe draw that center of gravity alſo nearer to the axis of the ſhip, from which it is ſo eſſential to remove as little as poſſible.

CHAPTER IV.

General Obſervations on the effect of more or leſs ſurface of ſails expoſed, in various weathers, to the wind.

I. WHEN a ſhip, under a certain ſet, or trimming, of ſails, has acquired the utmoſt velocity with the power which then puts her in motion, it is certain that, whenever the ſurface of the ſails is either increaſed or diminiſhed, the rapidity of the head-way will likewiſe augment or leſſen in a very complicated ratio. In order to find out the degree of impulſion of the wind on the ſails, you muſt multiply their ſurface by the ſquare of the exceſs of the velocity of the wind on that of the ſhip, or, which is the ſame thing, by the ſquare of the apparent velocity of the wind. Then, a ſecond multiplication of that product is to be made by the ſquare of the ſine of the angle of incidence abſolute, or, in the ſecond caſe, by the ſquare of the apparent ſine of incidence. Now, this ſecond product will give the degree of the abſolute impulſe of the wind on the ſails, in the actual ſtate which we have ſuppoſed.

IF you want to know in what ratio you are to augment the ſurface of the ſails, in order to make the ſhip acquire a certain degree of velocity above that which ſhe poſſeſſed under ſuch a particular quantity of ſail which you may ſuppoſe, you muſt firſt know by

how

how much the velocity of the wind exceeds that of the ſhip: then, knowing by how many degrees you wiſh her to accelerate the progreſs of her head-way, you will increaſe the ſet or the trimming of the ſails in the ratio of the ſquares of the two velocities of the ſhip; *viz.* that which was known before the alteration of the ſails, and that which ſhe is to have acquired ſince. But, as the ſhip recedes ſo much the more from the action of the impulſe of the wind as her velocity increaſes, it is evident the ſurface of the ſails muſt be increaſed alſo in the ratio of the ſquare of the two exceſſes, I mean the different exceſs of the wind over that of the ſhip both before and after the increaſe of the ſails: then, the ſhip will undoubtedly acquire, by theſe means, the wiſhed-for velocity; provided, however, no other cauſe happen to oppoſe it, as we have already hinted before, and as we ſhall have an opportunity to ſhew more particularly hereafter.

Suppose the wind has 12 degrees velocity, and the ſhip, under a certain ſet of ſails, has 3; the velocity of the wind, in the direct courſe, will exceed that of the ſhip but by 9 degrees. If, in this caſe, the velocity of the ſhip is wanted to come up to the third part of that of the wind, and take 4 degrees for her ſteerage or head-way; then the ſails are, to this effect, to be increaſed in the ratio of the ſquares of the two velocities 9 to 16, becauſe the oppoſition of the water on the prow will increaſe in that very proportion. But, in the firſt caſe, the velocity of the wind exceeded that of the ſhip by 9 degrees, while in the ſecond caſe it exceeds it no more than 8. Hence it reſults that the impulſe of the wind on the ſails has diminiſhed in the ratio of the two ſquares 81 to 64: and, in order to repair that loſs in the impulſion of the wind, the expanſion of the ſails is alſo to be increaſed in that laſt ratio of 64 to 81: then the ſhip will be able to run with the right degree of velocity which ſhe was wiſhed to have.

II. When

II. When the masting ſhall be perfect, that is to ſay, when the ſhip which is to be worked ſhall be maſted according to the *point-velique*, ſhe will riſe from the water parallel to herſelf by a certain quantity relative to her velocity, and that riſing will always increaſe more and more in proportion as ſhe will acquire new degrees of velocity in her head-way. The reaſon of this is, that ſuch a ſhip is moved by forces which ſtand exactly and continually in equilibrium with the action of the water on her prow, the forward inclination of which is ſo much the more contributing to that riſing out of the water as it is more remote from the perpendicular. For, then, the vertical impulſion muſt have more power, ſince it acts more directly on a very oblique prow than it would on a vertical one. With the ſame exactneſs, this reaſoning may be applied to the direct impulſion, the abſolute effort of which may be decompoſed, ſince it acts leſs againſt the velocity of the ſailing on an oblique prow than on a vertical one, while the other part of its action joins with the vertical impulſe to raiſe the head of the ſhip, which ſhocks the water with great ſtrength when ſhe is arrived to a very great velocity, a water which oppoſes her ſo much the more as it is ſhocked with a greater violence. So that it is eaſy to conclude that, in any ſhip whatever, the more rapid is the head-way, the more parallel to herſelf ſhe riſes above the water when the center of the effort of her ſails is at the ſame height as the *point-velique:* for, the point of the prow on which may be conſidered as united the action of the water which oppoſes its progreſs, may be taken alſo as that of bearing. So that all the ſails acting from aft to fore on various points of the axis of the ſhip, which herſelf may be conſidered as a lever in the directon of her length, they raiſe the after part of that point and place it on a level with the elevation of the prow; an operation which never can happen if the center of effort of the ſails is above or under the *point-velique*. If it is placed above, the power of the ſails, acting on too long levers, will raiſe the after

part

part of the point of bearing of the prow above the level of the elevation of the ſhip's head. If it is placed below, the power of the ſails, acting on too ſhort levers, the after part of the ſhip will remain plunged in the water without being able to riſe on a level with the prow. Therefore, in either of theſe two caſes, when the center of the effort of the ſails is either above or below the *point-velique*, however well-built a ſhip may be, ſhe will loſe ſome of her qualities, either in ſteering, or in her readineſs to obey the helm, or in ſhort in her ſteadineſs to carry her ſails, eſpecially if ſhe is over-maſted: for, in this laſt caſe, ſhe will gripe, incline eaſily, and loſe much of her head-way, ſince her prow will plunge in the fluid, or, which is the ſame thing, her ſtern will riſe too much out of it; which will diminiſh the action of the water on the rudder and increaſe it on the prow. In the laſt caſe, an inconveniency of which ſhip-builders ſeldom, if ever, have been guilty, the ſhip will be ſlow to obey, and her head-way will be ſlackened, becauſe ſhe will never be able to preſent her moſt advantageous water-lines to the fluid, nor have a ſufficient ſurface of ſails, as, although their width is the ſame, their perpendicular length is not ſo. Hence we muſt, therefore, conclude that the true point of perfection to be aimed at and obtained is only this, *viz.* when the center of effort of the ſails is placed at the height of the *point-velique*.

III. I AM now going to lay down a propoſition which will appear a monſtrous paradox to many ſeamen. But, it ſeems to me too ſelf-evident a truth to refrain from promulgating it; eſpecially as it can be oppoſed but by mere habit and cuſtom; and, indeed, ſuch motives are little worth being regarded.

I MAINTAIN that there are many caſes in which the adding of a few ſails, inſtead of increaſing her velocity, poſitively retards a ſhip's head-way. It is notwithſtanding an error in which all ſeamen almoſt continually fall into, when, in a ſtrong gale, they want either to recede from, or approach, a ſhip they want to avoid or chaſe.

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When their ſhip is arrived to a very great pitch of velocity (ſometimes of twelve and more knots an hour), if they have to do with an adverſary the rapidity of which is nearly equal to that of their own ſhip, they fancy that, by adding more ſails to thoſe they have already, at the time when their ſhip is perhaps beſt diſpoſed and arrived at its utmoſt degree of ſwiftneſs, they will increaſe the rapidity of her head-way; and, accordingly, they hoiſt up ſome additional ſtay or ſtudding ſails, eſpecially if the wind happens to be on the beam or a little more aſt. But, there happens then quite the reverſe of what they expected; for, the ſhip becomes more inclining, her head plunges, and, the reſiſtance of her prow increaſing in the direction of the keel more than the effort of the ſails in the direction of the head-way, the rapidity decreaſes in ſo much as the water acts more powerfully than the ſail does relatively to the obſervations we have juſt made. Beſides all this, thoſe forward and lateral inclinations of the ſhip, produced by the effort of the new-added ſail, which have cauſed the center of effort of the ſails to aſcend, and the *point-velique* to deſcend (if the new-added ſail has been ſet above it), cauſe alſo the ſhip not to riſe from the water parallel to herſelf; ſhe riſes her ſtern and plunges her head; whence it reſults that ſhe becomes griping from two cauſes: firſt, becauſe, as her ſtern lies leſs in the water, the rudder is of courſe expoſed to a leſs ſhock; and the ſtern, which always acts as good as any ſail, is more eaſily maſtered by the wind which ſtrikes it then on the beam with a great deal more efficacy than it does her head; on the other hand, as the lateral part of the reſiſtance of the water on the leeward part of the prow has been increaſing by the inclining of the head, which has plunged that part of the ſhip which is the moſt ſwelled and bellied in its careen, and thereby increaſed alſo the ſurface on which the water acts, which has both diminiſhed the head-way and increaſed at the ſame time the lateral impulſe on the ſide of the prow; ſo that lateral impulſion forces the ſhip to windward more at the head, than ſhe is impelled to fall off by the lateral

part of the effort of the new-added ſail. Whence it follows that the ſhip becomes ſtill more griping, which is an additional cauſe of her head-way's decreaſe; becauſe, the helm of the rudder being more a-weather in order to keep the ſhip more on her ſtanding on, a great deal more of the rudder itſelf is offered to the run of the water, by the great ſurface it offers more directly to its ſhock; and, by ſuch means, oppoſes the current of the water-ſtreams, and retards the velocity of the ſhip. Whence we are to conclude that as ſoon as any more ſails are added to a ſhip which carries already a ſufficient quantity of them, ſhe will loſe her qualities of ſteering well and making a good head-way through the water: whether thoſe additional ſails are ſet forward or a-ſtern, it is indifferent; they will always be equally noxious and detrimental.

CHAPTER V.

Particulars to be obſerved in the fitting-out of a ſhip, in order to accelerate the execution of it.

WHENEVER celerity is required in the buſineſs of fitting-out a ſhip for the ſea, order muſt be introduced in the diſpoſition of the different branches of that operation as well as in the attending cloſe the execution of them. So that, when you have once begun a certain particular object, ſuch as rigging, ballaſting, or ſtowing, &c, &c, &c, you muſt attend it cloſe till it is finiſhed, before you attempt another which, in its turn, muſt likewiſe be attended the ſame.

AMONG the various operations which are to be executed in the courſe of the equipment, there are a few things of mere obſervation or detail, which may be either prepared before-hand, or ſo diſpoſed as to be ready for the time it will be proper to ſet about them. Accordingly, you have only to ſelect a ſmall number of ſailors, or other workmen, ſuch as are known to be the moſt aſſiduous and ſkilful, under the command of an intelligent mechanical officer, and

theſe

these people will forward the preparations without its being hardly perceived; so that, when you come to set about the business for good, every thing goes round and easy, without being stopped at every instant by a thousand minute particulars.

The officer on duty, or charged with the inspection of the works, will report to the Captain in the evening every thing which shall have been done in the course of the day, and agree at the same time on what is to be done the next. When this is once agreed on and settled, the order must stand good and subsist without its being allowed or permitted to be interrupted at any time during the course of the work, unless some unforeseen accident and of great moment should happen.

We must remain intimately persuaded of this truth, *viz.* that it is always attended with the loss of a vast deal of time when we are obliged to pass on a sudden from a business begun to another which is just ordered, and then to quit this to pass again to a new one or to return to the first. This busy uncertainty alone puzzles the workmen, and disgusts the very leaders themselves of the works; and the want of order can never produce but dilatoriness in the execution of an operation, let it be whatever it will.

I am not unaware that more than one object may sometimes be undertaken at once; and I even advise to put it in practice whenever there will be any possibility so to do. But, I nevertheless return to my first principle laid down, that all works begun ought to be conducted to their end, without interruption, by the same hands as undertook them, before those hands are put about any other sort of business.

One must seldom set about doing any kind of business, when every thing is well ordered, unless one is morally sure of being able to bring it to conclusion without any interruption. It is a general principle that no mariner is allowed to be ignorant of. There are notwithstanding such moments and intervals of labour which are not to be wasted. In these circumstances, the hands are to be set about

certain preparations or certain ſmall operations relative to works one foreſees or knows to be ſoon undertaken. It is at ſuch times activity is not to be abated, nor any hand ſuffered to remain unemployed; for, if inaction and idleneſs is once ſuffered to lay hold of them, it can in the end but make them weak, ſlothful, indolent, and effeminate.

CHAPTER VI.

Of the careening and ſcupper-nail-ſheathing of ſhips.

I WILL not attempt to give here an account of all the particulars concerning the diſpoſitions neceſſary for, or the act itſelf of, heaving down a ſhip in order to careen her. Seamen are ſo well verſed in theſe operations, and they are ſo ſimple and ſo eaſy to be conceived by thoſe who never have ſeen them done, that it is better to refer people to experience than to undertake here a deſcription of the ſubject. But, we ſhall make it our buſineſs to deſcant on what might beſt be done for the preſervation of ſhips and preventing them from being worm-eaten.

IT is a great while ſince the means have been ſought for to prevent worms from eating the wood, lodging themſelves in it, and boring it, as they do, in all the ſhips which have gone long voyages, or which remain in harbours and roads the ground of which is oozy and fit to produce, or favour, thoſe gnawing inſects. Every thing which has hitherto been attempted in that reſpect has proved unſucceſsful; and nothing but the nail-ſheathing has been yet known capable to preſerve the ſhips from that accident. Therefore, we will direct our thoughts to that ſort of expedient of ſheathing ſhips; but we propoſe to improve upon it, and to adviſe to do it a new way: for, I am fully convinced that the preſent method of doing it, which is by covering the bottom with ſcupper nails, is very defective, for the following reaſons. As the ſurface of a ſhip's bottom is very uneven, the head-way of a ſhip, thus ſheathed with nails,

nails, decreaſes very much, owing to the increaſe of reſiſtance of the fluid; the firſt objection. The ſecond is, that if the ſhip happen to leak, either through the looſeneſs and play of ſome of her parts, or through the want of oakum, which rots in time, within the ſeams of the planks, you muſt loſe in the careening all the ſheathing and the nailing, which is attended of courſe with a great additional expence. And a third objection is, again, that it often happens a ſhip comes out of the harbour quite tight and dry, and is no ſooner offward but ſhe leaks, becauſe the labour of the parts which are covered with the nails occaſions, frequently, the ſcarfs to give way.

To remedy, therefore, all theſe inconveniencies, I would propoſe to ſheath the ſhips with nails on the free planks of their bottoms, and to employ for that buſineſs nails one inch and an half long, with heads at leaſt one inch diameter, and nearly like thoſe which ſerve to faſten the iron bands on the waggon wheels. Such nails ſhould be placed alſo in ſuch a manner as would admit of two or three lines diſtance between each nail's head, ſo that the ruſt might communicate from nail to nail and occupy all the diſtance between them; for, ruſt is the only thing which really prevents the worms from getting into the wood. And, in order to remedy the unevenneſs of the bottom's ſurface, it will be proper to make with a gouge a cavity in the plank of the ſame depth as the thickneſs of thoſe nails heads, that they may be ſunk in it and thereby appear on a level with the ſurface of the wood.

On each ſcarf, or on each plank's end, I would alſo have two iron cramperns, with pikes, vertically placed, and ſo incruſted into the wood as not to appear above it. All this being done with care, and the ſhips being next well caulked with the horſing-iron, ſo that the ſeams be as narrow as poſſible, you will pay the whole bottom all over with a liquid pitch, this ſpecies of brown coat being preferable to the paler ſort, as it ſticks better.

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The advantage which will result from that mode of careening ships will take less time in sheathing, and will render careening itself more easy; besides, it will facilitate the visiting and examining of the ships, whenever it may be found necessary, without being stopped in the operation by the sheathing or the nails: there will be no need of employing so many carpenters; in short, in the Colonies, the expence will be found much less than it is now.

One might again, after the method of the inhabitants of Surata, build and careen ships so as to last a hundred years, by paying their bottom all over, and even on the free planks, with a coat of *galgalle* * well-made after their own way, and the seams covered with *sarangousti* †.

If you want absolutely to sheath your ships, it will be better to do it with sheets of copper as thin as paper. The English have tried it, and it has succeeded. The first expence will appear costly, but that copper is melted a-new for each careening. It is to be observed this sort of sheathing never becomes foul, and must be nailed with copper nails, because the iron ones becoming rusty would all fall off.

CHAPTER VII.

Of the scantling in men of war, and in general of the strengthening-pieces.

THIS is a subject for the general cry of all the Navy, and not the least reasonable is it I must confess.

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* *Galgalle* is a composition of oil, quick lime, and oakum, mixed together, with which they grave and pay a ship's bottom in India.

† *Sarangousti* is a kind of mastick, superior to any other, used in India for the purpose above mentioned.

THEY have of late years built exceeding good veſſels, and they continue, it is true, to build ſuch now; but I cannot help obſerving that thoſe ſhips might ſtill be improved in their form. After having blamed the exceſs of height in the maſting of ſhips, I think myſelf authoriſed in pointing out the defects of their ſcantling: and I think I am ſo much the better grounded in doing it, as it is from a perfect knowledge of the error, that I embrace this opportunity to reprobate it.

IT muſt be allowed that the ſhips which are built now on the modern principles are in every reſpect ſuperior to thoſe of former times; they are undoubtedly learnedly built. But, neverthleſs, if they go on much longer on the plan they have adopted, it cannot be denied but they will ruin Government at laſt, by the ſhortneſs of their duration. They cannot ſtand an action as long as our old ſhips uſed to do, through the body of which the bullets formerly did not paſs, but remained in the planks. Experience has ſufficiently proved it, and the *Tonnant*, an old ſhip, ſhews it ſufficiently to all the Navy, while thirty others of the modern conſtruction witneſs at this time, in every part of the world, that there is not one of them but may be pierced at the water-line by a twelve-pounder. A diſadvantage which might eaſily be remedied, if, inſtead of giving them 17 or 19 inches ſcantling perpendicular to the lower battery they had 24 or 28; and if, beſides, they were built full of wood from eight feet lower than the water-line up to the ſecond deck, as it ſhould inconteſtably be in ſhips which are deſtined to carry twenty-four and thirty-ſix pounders, and to fire in line. A ſhip thus built will have undoubtedly a great advantage in cannonading over a thin ſhip expoſed to be pierced through and through at every broadſide ſhe receives, and who cracks in ſhivering under the iterated concuſſions occaſioned by the quick firing of her own artillery. On the other hand, theſe kind of veſſels, thus ſtrengthened, might be made tighter than the others; becauſe it would be eaſy to faſten their ſeveral parts one upon another with iron ſcrews, beginning at one

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end and continuing thus to the other. The timber-work holding in this manner all together, could not eaſily labour in one place without being ſupported by the remainder: ſhould two parts tend to divide, they could not do it without breaking ſeven or eight ſcrews, and without forcing upon the other neighbouring parts. When ſuch a ſhip would come to board another of a weak ſcantling, whatever might be the weather or ſea, ſhe would preſent her a maſs, which, without being of a much larger ſize, would be of a very different ſolidity, a ſolidity which would ſave her from ſuffering ſo much as a weak veſſel, all the parts of which play if ſhe is ever ſo little hurt, as ſeamen have many a time experienced it, in ſundry ſimilar events of this kind, and as it is eaſy to verify it whenever we navigate modern ſhips which are weak, not only through their ſcantling being unable to ſtand its own iron-work, but alſo through the fault of their interior ſtrengthening-pieces, and the great diſtance there is between a broad thin beam and another, and the over-weakneſs of theſe ſame beams, which being neither thick nor wide enough are not capable to ſupport the forecaſtle nor the quarter-deck, on account of the weight of the iron artillery with which the men of war are obliged to be loaded. So that, after a campaign of ſix years in the Colonies, and ſometimes leſs, theſe veſſels are at their return home expoſed to be rebuilt or condemned. The ſame happens with the flutes or ſtore-ſhips, the ribs of which being all looſe, leak every where, between decks and the hold, as ſoon as they are toſſed about by a heavy ſea, which, in a ſtrong gale, they very often ſhip by over the waiſt.

If they thought to get much in the building of ſhips by the lightneſs of their weight, they have certainly ſucceeded to admiration in that reſpect. Notwithſtanding, I believe that, if naval architecture had received no other improvement but this, we ſhould be ſtill expoſed to be bleſſed with no better than hawkers little fit to go with rapidity from one place to another, and to manœuver in preſence of the enemy. For, it is evident that a light ſhip, made

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on the ſame pattern as another more heavy, has no better diſpoſitions to divide the fluid than the other, ſince ſhe offers the ſame ſurface, and ſhe has the ſame quantity of water to overcome, being both obliged to take a ſufficient and proportional quantity of ballaſt in order to ſink both equally to the ſame water-line. Moreover, how much more do you think the heavieſt-built ſhip will ſink into the water on account of its greater quantity of wood? Two or three inches only, and no more. For, ſuppoſe there ſhould be in the conſtruction of the one about thirty or forty tons of wood and iron more than in the other, any one may take notice that when ſuch a ſhip (which I ſuppoſe to be a ſeventy-four or eighty gun ſhip) is ready to take the ſea, forty tons more or leſs will not be capable to make a difference of two inches in its ſinking. Beſides, the ſize of the veſſel may eaſily be increaſed in the ſame proportion as the weight of wood and iron which will be ſuſpected to enter in her conſtruction, without its being any way detrimental to her good quality, whenever ſhe ſhall be commanded by an able Officer, who will know how to manœuver his ſhip to the beſt advantage. Such was and is ſtill the ſhip *Comte de Provence*, built at Port l'Orient by Mr. Coulon. This ſhip has been the admiration of all the mariners who have ſeen her navigate, either alone or in ſquadron. At ſix feet under her lower deck ſhe had all the good qualities which can be wiſhed for in a ſhip of the line; at ſix feet eight inches, ſhe loſt none ſtill. The only fault one has been able to reproach that unparalleled ſhip with, is the weakneſs of her ſtrengthening-pieces and of her ſcantling, which was but nineteen inches thick in the middle of her lower tier perpendicular to her ſide, with too much room and ſpace between her ribs; ſo that eight pounds ſhot pierced her through and through, even in the gangway of the orlop. That ſhip, ſay they, would have loſt ſome of her good qualities, had ſhe been ſtronger in her ſcantling as well as in her ſtrengthening-pieces. But, what an effect, I ſay, could forty tons have produced on ſo conſiderable a careen?

Again; ſhould one be afraid, in the preſent ſituation of things, to increaſe too much the weight of the upper works, it is eaſy to take part of that weight away from the height of the dead works. Five feet two inches height between decks under the beams, for ſuch ſhips as carry thirty-ſix pounders, are full ſufficient to ſerve the artillery with eaſe. (Care alſo may be taken, by the bye, to garniſh the part above the vents of guns with only tin plates.) Now, five feet for the height of the gunwale, and a little more than that aſt, under the quarter-deck, will certainly do very well. Next, let there be on the poop neither ward-room nor cabin, that is to ſay, neither top-gallant poop nor poop-royal, and let every thing elſe thus be proportionally diminiſhed which belongs to the upper works; it will ſoon be eaſy to get back that way what might have been loſt on the other: for, the artillery of the ſecond deck, as well as that of the forecaſtle and quarter-deck, will be a little lower, by which means the center of gravity will perhaps have lowered rather than it will have heightened through the increaſe of wood and iron. After all, the builder cannot evidently fail, in calculating his plan, to know to a tittle what he can get or loſe in reſpect to the qualities of his ſhip; and that will be a trouble attended rather with expence of time than with difficulty.

It will be again very eaſy to diminiſh the top weight by the mode of rigging, as we ſhall ſhew it hereafter. On the other hand, there will be likewiſe a poſſibility of lowering the center of gravity in not taking on board to ſea ſuch a quantity of uſeleſs anchors, which only fatigue the ſhip; two of them are ſufficient there. The others may be placed in the hatchways, and their ſtocks between decks, ready to hoiſt up at the approach of land. In ſhort, there are a thouſand ways to lighten the upper part of ſhips, and to ſtrengthen them in their timber, without expoſing them to loſe any one of their good qualities.

The lives of the men, which one ought always to have in view to preſerve as much as poſſible, is an object of the firſt conſideration and

and importance. It is clear, from what I propoſe here to do, that the gunners who ſerve the artillery will not be ſo much expoſed in the battering of a ſhip, the ſcantling of which will be ſtrong, as in thoſe of the modern ſhips; for, very few bullets will be able to get through her ſides. Theſe men will therefore be able to reſiſt longer againſt ſuperior forces, and to ſtand with more advantage againſt equal ones; and eſpecially at this time when boarding is no longer practiſed, and all its advantages unknown; when long, tedious and ſlaughtering cannonading is preferred to coming to a ſhort, deciſive and more courageous way of fighting, which is at the ſame time infinitely more ſuitable to the temper and natural vivacity of our Nation, which has not the phlegmatic coolneſs of her competitors in that mode of fighting. In ſhort, let us render our men of war ſtronger, and they will gain by it in action: let us render our *flutes* or ſtore-ſhips more ſolid, and they will be more fit for trade.

THE ſhips may be ſtrengthened in their length by making what are generally termed the *ſtrengthening-pieces* ſtronger than they are now uſually made; by indenting, beſides, the deck-planks with two more, one of which on the beams, like the binding ſtrakes; and by making the decks ſtrait from one end to the other without any ſheer, and the beams likewiſe without any rounding-up or convexity. It will be eaſy to give them that degree of convexity neceſſary for the water to run off, by adding a piece of wood on the middle of each beam, cut in ſuch a manner as to make it a ſegment of a circle, over which the planks will be fixed. One may again in the holds place ſome iron bars acroſs, in form of buttreſſes, four inches ſquare, which will prop arch-like in croſſing each other from the top of the ſtanchions, which carry the weight of the deck, to the foot one of another. Such a contrivance would prevent the play of the whole machinery in general, by the ſtrong oppoſition it would make to the top part weighing down, without obſtructing in the leaſt the ſtowage. It will be proper to join the

quarter-deck and forecaſtle together, and to leave between the gang-ways only the ſpace neceſſary for the paſſage of the boats; which will give two rows more of binding ſtrakes from one end of the ſhip to the other. Such binding ſtrakes might again be placed from one end of the ſhip to the other on each ſide of the ſtanchions, riſing five or ſix inches above the decks in order to augment the ſtrengthening the length-way without obſtructing the guns. All theſe additions of wood and iron works will perhaps render the whole maſs more heavy, eſpecially if care is not taken to do as we ſaid before; I mean, to take off one way the weight that is added the other, by diminiſhing the lading. But, as the qualities of a ſhip depend but upon her ſhape, more or leſs advantageous for ſailing, ſteering, carrying her ſails more or leſs ſtiff, &c, and on the perfection of the trimming of her ſails with reſpect to the various impulſions to which ſhe is expoſed; it is evident that more or leſs maſſiveneſs in her can have no influence over thoſe qualities, ſince in both caſes the quantity of water ſhe is to diſplace is the ſame, as well as the reſiſting impulſe, ſince the water-lines at the prow are alſo the ſame in every circumſtance. I go ſtill farther: let the outſide of the outer beam be increaſed in thickneſs equal to that which will be added to the ſides of the ſhip, and let the length abſolute of that beam be four or five times that addition in the ſtrength of the ſcantling; all that put together will never come to ſix or eight feet in the ſeventy-four gun ſhips, becauſe their additional width will not be more than ſixteen or twenty inches, which will not alter in the leaſt the center of gravity; but the volume of water ſhe is to diſplace will be more conſiderable, in proportion, than the total of the weight added to the ſhip; whence, conſequently, her ſolidity will be increaſed alſo, as well as her power to carry her ſails, without loſing the leaſt advantage of her water-lines, which will always have the ſame ſine of incidence with the meeting of the fluid; a truth which it would be eaſy to prove to a demonſtration.

CHAPTER

CHAPTER VIII.

Of the housing-in of the top-timbers.

THE housing-in of the dead works in men of war is so considerable, that the guns of the second tier or deck have hardly room for their necessary recoil between the long-boat and the board: so that one is obliged to put the spare top-masts on the gallows bits, where generally they seldom fail being soon cut to pieces by the shot. And, if they happen to be thus treated during an action, they fall on the deck when the gangways are not close to the boats. Then they encumber the guns in such a manner as to make it impossible to use them for a good while. The Officer who commands the battery, and those above who occupy various stations, find a deal of trouble to go from one end to the other to give orders and to attend to every thing. That fact is well known; nor are the builders without foreseeing it in their construction: but, as they themselves do not get on board, they are not sensible enough of the absolute necessity of allowing so much more room as what they are wont to do. There have, notwithstanding, been able builders who have built exceeding good ships with very little of what they call *tumbling-home*; for, this mode of building adds nothing to the qualities of a ship; but they have not made any proselytes, and that form so preferable to ancient practice has not yet got the better of the old way.

THE Regulations on Cruizing, published in 1757, encouraged boarding, while in all the sea-ports of France all the builders seemed to have made a compact together to build frigates and men of war with so much housing-in that it was next to impossible to execute boarding, as there was a space of ten or twelve feet to leap over between the waists of the two ships fastened together with grapnels, a circumstance which adds again a new difficulty to the

boarding

boarding by the perpetual and inceſſant motion of the ſhip it occaſions in rolling and pitching. Was there no oppoſition or defence to be met with on the ſide of the ſhip attacked, one might perhaps find means of boarding her, and yet it would not be without trouble: *à fortiori*, when, inſtead of being able to ſtretch the hand one to another, one is received with ſwords and piſtols, and ſo many other ways which are made uſe of to repel the enemy, and render it impoſſible to ſucceed in that attempt. That way of houſing-in muſt therefore be diminiſhed as much as poſſible, in order to facilitate that mode of fighting which of all is the moſt advantageous and the leſs ſanguinary.

If little or no houſing-in comes to be given to the frigates and men of war, then it will be very proper to increaſe alſo the ſtrengthening-pieces in the direction of the length; by which means their artillery will become more at a diſtance from the axis, but not more above the center of gravity. The ſhip will therefore poſſeſs the ſame quality of carrying her ſails very ſtiff: ſhe will poſſeſs that other alſo of rolling more eaſy, and not ſo hard as, through that immenſe weight of the artillery of the upper deck, quarter deck, and forecaſtle, ſhe did before; and which, being now carried on each ſide of the point round which the balancing is made on levers which have increaſed in their length by all that which has been diminiſhed of the tumbling-home of the top timbers, will enable her of courſe to oppoſe better the motion, ſince ſhe will form larger arches. Therefore, there is nothing poſitively to loſe, and on the contrary a great advantage to gain, by the diminution of that trimming home; for, the ſhip will preſent a wider ſpace for engaging, ſhe will roll eaſier, and her maſting will be better ſupported; advantages which are various, and on the reality of which there is no reaſon to doubt.

In the extreme and utmoſt inclination poſſible (ſuppoſing that a veſſel well-built and well-ſtowed ſhould ever be liable to it) the ſhip

ſhip which ſhall have no houſing-in will preſent a greater and greater ſurface to the water in proportion as, in heeling, ſhe will get deeper and deeper into it: ſo that the direction of the vertical impulſe of the water will always be above the center of gravity of the ſhip in cutting the line on which it is placed with the metacenter. By this mean the effort of the water will always ſet the ſhip up again, however inclined ſhe may happen to be; a property which no other ſhip with a great houſing-in can ever poſſeſs; for, if ſuch a one, in coming to heel, ſhould ever come to paſs her extreme breadth, then the vertical impulſe of the fluid ſtrikes her under her center of gravity, and compels her immediately to overſet.

I WAS once in a large veſſel which had but little houſing, but which, on the other hand, was in every reſpect ſo badly built, that I may well ſay ſhe had no other quality but that of being able to take a large cargo. She inclined eaſily, though (very luckily for her maſting) ſhe was ſo large. One day, among others, as we had all the ſails out, we were caught by a violent gale which turned us on a ſudden on our ſide, even ſo much that the guns of the lower deck went to the water, though they were ſtill nine feet higher than the level of the ſea, which was at that moment as ſmooth as a glaſs on the weather ſide. We remained above twenty minutes in that diſtreſſing ſituation, from which we were not relieved but by the loſs of almoſt all our ſails, which were carried away by the violence of the wind. Had that ſhip had much houſing-in, with ſuch an inclination of near thirty-five or forty degrees, there is not the leaſt doubt but ſhe would have turned clean over: for, if her center of gravity was high, the metacenter was a great deal more ſo ſtill, ſince the water always met with more ſwelled parts which oppoſed it; but if ſhe had notwithſtanding carried her heeling beyond her ſwelling and as far as her houſing-in, which was very high though of very little depth, it is moſt likely it would have been attended with worſe conſequences for us.

CHAPTER

CHAPTER IX.

Of the ballaſt and lading.

WHEN a ſhip is in lading, one muſt firſt admit of the truth of this principle, *viz.* that the ſoftneſs or hardneſs of the rolling and pitching depends not altogether ſo much on her ſhape and form alone, as on the more or leſs advantageous diſtribution of the heavieſt parts of her cargo.

THE moſt particular attention, for example, is to be paid to the moderating of her pitching, as that is what fatigues moſt a ſhip and her maſting; and it is moſtly in one of theſe motions that maſts are ſeen to break, particularly when the head riſes after having pitched. Although the rolling be proportionably more conſiderable a movement than pitching, it is but ſeldom any accident is ſeen to ariſe from it, as it is always a ſlow one. Notwithſtanding it is not leſs proper to prevent it as much as poſſible. This will eaſily be obtained, without being any way detrimental to the ſhip's ſtiff carrying of her ſails, if, when the ballaſt is in iron, you ſtow it on the floor-timber's ſcarfs; becauſe it will recall the ſhip with leſs violence after her having inclined, and will act on a point a little diſtant from the center of gravity. It will be proper to obſerve likewiſe not to make it aſcend too high on each ſide of the ſhip, and to fill up the vacancies which are between the firſt and ſecond plank of the wood ballaſt, then to ſtow the remainder ſmooth and even. Next to this, when all the ballaſt is well diſpoſed round and under the center of gravity of the ſhip in the form and manner juſt laid down, and drawn a little (that is to ſay, between 20 and 30 feet) fore and aft that point, ſo that the ſhip ſhould find herſelf juſt at the draught of water marked by the builder, you will ſtow over it in a ſolid manner the cargo, in obſerving to begin by placing firſt and at the bottom the loads which are moſt heavy and capable to ſuſtain the weight of thoſe which are to be ſtowed over them.

WE

We place the ballaſt round and very near the center of gravity of the ſhip, becauſe it will prevent the motion of the pitching being ſo hard as it would, were that weight more diſtant either afore or abaft that point. Whenever the ſea runs a little high, the ſhip is never carried by a ſingle wave; there are two or three always paſſing under at the ſame time, unleſs it is when the ſea is extremely long and the ſwells come from a great diſtance, and in latitudes vaſtly remote from land: for, then, it happens that the largeſt ſhips are ſometimes carried by one ſingle wave. But, in either circumſtance, I maintain the ballaſt ought not to be ſtretched afore or abaft the center of gravity, as ſoon as the ſhip is in the parallel to her draught of water marked for the ballaſt, which it is abſolutely eſſential to pay great attention to. To prove what I lay down here as a principle, I will ſuppoſe in either caſe a long or ſhort ſurge, and that the water comes and hits the ſhip afore, that thereby ſhe may be conceived as expoſed to the circumſtance of the greateſt and hardeſt pitching, as I myſelf have experienced many a time: for, in this caſe, when the wave takes the ſhip under the ſtern, her motions, if ſhe has got a little head-way, are not dangerous; becauſe, as ſhe flies before the wave, ſhe recedes in ſome meaſure from its impulſe; while, in the other hypotheſis, ſhe increaſes on the contrary that ſame impulſe in the ratio of the ſquare of all her velocity.

First, the ſhip whoſe extremities are light or leſs loaded, being ſuppoſed to run with any velocity whatever againſt the wave which comes to her a-head, ſhocks that wave undoubtedly with a force expreſſed by the ſquare of the ſum of the two velocities: ſhe divides it and goes through it at the ſame inſtant as ſhe is raiſed by the vertical impulſe of that column of water which oppoſes her a weight more conſiderable than is the diſplacing of it: the wave which follows produces the ſame effect in receiving the fall of the ſhip, becauſe the firſt is already under the middle of the ſhip,

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whence it passes to the stern, which is supported by it, while the second has already taken its place in the middle, and the third is come to support the head by a continual and uninterrupted succession of waves. This motion continuing thus as long as the sea is in agitation, it follows the ship is never at rest: no sooner has she been raised by a wave, but she falls again when that wave is gone, which falling is proportionably less sharp as her head is less heavy: the shake is then less violent, since she shocks the water with a lesser mass, which prevents her pitching so deep as she would, was she more heavy; consequently, the masting does not suffer, and the velocity of the steering is less delayed, as the most swelled part of the prow is not so much exposed to the shock of the water.

Secondly, when the ship is carried by one single wave, it stands to sense that her fall is still less sharp, if little loaded a-head, when she is no more carried but by the middle. She rises, therefore, more easily at the moment the other wave comes to meet her, and the shake is not so violent. Was she to plunge deeper into the fluid, it might happen that the column of water would be higher than her head, and, passing partly over it, would expose her to the imminent danger of foundering.

REMARK.

In the stowing of the cargo, it is proper to place the heaviest part of the stowage as low as possible, and to take care to preserve the draught of the ship which is most advantageous for her qualities, whether on her ballast or when laden. Those points are marked both at the head and stern; and they should be so likewise in the middle, in order that one should not be exposed to deviate from the water line and from that situation of the ship which is most favorable to every thing which may be required of her, as she must be placed in the situation most advantageous for dividing the fluid, and to behave well at sea in all kinds of weathers. In a word, the great art of stowing, lies in endeavouring that each of the vertical parts

parts, in which the extremities of a ſhip may be ſuppoſed to be equally divided, be lighter than the weight of the maſs of water they are to diſplace; and ſhould the penetration of any one be ever ſo weak, it is impoſſible not to diſcover a multitude of advantages in it. We are not to forget, however, to take notice that the vertical parts of the middle admit of being loaded heavier than the weight of the volume of water they are able to diſplace.

CHAPTER X.

Of the rigging in general.

THE art of rigging ſhips is the higheſt pitch of ſkill in the ſea Officer and in the ſailor. Therefore it is a kind of knowledge too eſſential to be diſpenſed with by the Officer; for, the rigging not only ſerves to ſupport the maſts, but alſo to manœuver the ſails, ſince at every moment it ſerves to diſpoſe of them one way or the other, in order to give the ſhip the various motions which are requiſite. It is therefore indiſpenſably neceſſary to have a perfect knowledge of the rigging.

MANY Officers are thorough maſters of that buſineſs, but none have yet turned their thoughts to the reform which this branch of the manœuvre is ſuſceptible of, for the beſt. This is, therefore, preciſely what we are going to undertake here, in treating of this ſubject at large, and without entering too minutely into particulars.

THE diminution of weight and bulk will be our principal object, perſuaded that both the one and the other are inconveniences very unfavourable to the qualities of a ſhip.

THE firſt thing which I would, therefore, remove in the rigging, is that prodigious quantity of ſervice which is employed about every thing and every where. The ſheets and tacks of the courſes, as well as thoſe of the top-ſails and their tyes, are ſerved and parcelled in ſuch a manner that, through that abuſe, they are generally a quarter bigger than the rope with which they are made. So that,

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when you come to haul aboard or tally thoſe ſails, the friction becomes ſo conſiderable, and ſo hard, that it is not without the greateſt pain and labour you execute it. If theſe ropes, which I could wiſh always to be ſingle, with reſpect to the lower ſails, and without any other block on the clue of the ſail than that of the clue-garnet, were ſerved but at three feet diſtance from the clue, they would not be inferior in point of goodneſs for it. The ſerving of a rope does not ſtrengthen it; it is uſed only to prevent its being chafed in the block through which it is reeved: therefore, ſhould theſe ropes be ſerved no more than we ſay, they would be ſtill ſufficiently ſo; ſince there is but one point of them which is to reſt on the ſheave. As for the ropes of the lower ſails, their reſting point is inceſſantly changing, as they are veered away more or leſs, according to the ſituation of the tacks and ſheets* they belong to, and which ſhould always be ſingle; for, if they are employed double as cuſtomary, they are nevertheleſs always ſingle on the ſheaves, which, after all, comes ſtill to the ſame point, with reſpect to the power of reſiſting.

The tyes of the top-ſails are nothing more than running ropes, which are to be ſuch as to admit of being eaſily reeved in the blocks: therefore they muſt by no means be ſerved, unleſs they be fixed and faſtened on the yard: and, in that caſe, it will be proper to ſerve them about the length of three or four feet from the yard. The ſame may be ſaid of the ſheets and tyes of the top-gallant ſails.

The ſhrouds and ſtays ought abſolutely to be ſerved no where elſe but at their collar and catharpings; the ſtrops and pendants, of all denominations, at their collar only.

In men of war, as well as in any other kind of ſhips, I would not abſolutely have any parrels nor running tackles at the lower yards: they

* In England the tacks only are ſingle, and the ſheets always double.

they are only ſo much more weight above, and ſo much uſeleſs rigging which ſhould abſolutely be ſuppreſſed, and ſupplied by 5, 6, 7, 8, 9, or 10 inch-ropes, according to the ſize of the ſhip. This is the manner in which I have ſeen it executed upon ſome large ſhips. You place on the yard a ſtrop on each ſide of the maſt, with a thimble, or bull's eye, wide enough that the rope may be introduced in it with ſufficient facility. When that is done, you introduce each end of your rope in one of the thimbles, ſo as to go out abaft the maſt and acroſs one of the other, in order to be brought afterwards on each ſide of the yard between the maſt and ſtrops; then you hook a ſmall tackle on the bight of the rope which deſcends along and a little abaft of the maſt. That tackle ſerves to tighten or eaſe the parrel,* according as you think fit, and as the weather requires. If it is very bad, you haul it very taught, and the yard then has no play. Let the ſhip pitch, roll, or toſs about as much as ſhe will, the yard is ſo well fixed that there is neither play nor ſhake from it on the maſt. Beſides the handineſs which reſults from ſo ſimple a machinery, it has again the advantage not to weigh the quarter of our ordinary parrels, nor to have the eighth part of their bulk. It requires no great difficulty to make it; for a piece of rope is all that is required for it; and if, by chance, a ſhot comes to ſtrike it, there is however no apprehenſion of being knocked on the head by a rib or a truck, as is the caſe with other ſorts of parrels.

The parrels of the top and top-gallant yards, ſuch as they are generally made, are not good for any thing. A common rope of 2, 3, 4, 5, or 6 inches, according to the ſize of the ſhips, with ſix or eight trucks upon it, is quite ſufficient; you have but to faſten it on each ſide to the yard, when on the cap, without making it too taught upon the maſt. Such a parrel will be infinitely more ſimple, leſs heavy, and more eaſy to handle, than the other kind.

It

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* Parrels have not been in uſe for the lower yards in the Britiſh ſervice theſe thirty years.

It is again cuſtomary to fix at the head of the lower maſts two main gear-blocks, with two or three ſheaves each, for the uſe of hoiſting the lower yards, on which they ſtrop alſo two other blocks which correſpond with the two firſt. All this is abſolutely uſeleſs: it is only a very conſiderable weight on the head of the maſts, as well as a very great bulk, both of which muſt abſolutely be ſuppreſſed. It will be ſufficient to hoiſt the lower yards with two ſmall winding tackles, which ſhall be always kept in readineſs for uſe, in order to hoiſt them up, or haul them down, according as circumſtances require; and, when the yards ſhall be up and carried by their ſlings, then you take your winding tackles down. The two ſtrops over the yard, which you rack with the ſlings, being well placed in the middle of the yard, this will be much better balanced and labour much leſs when the tacks come to be hauled aboard. Now, no ſuch advantage can be obtained when there are any ſtrops over the yards; for, a certain diſtance is neceſſarily required between each of thoſe ſtrops; whence it reſults, that the yard can never be well balanced except when the wind is right aſt.

After the lower yards ſhall be well balanced on their ſlings, you will belay their lifts and make them quite faſt for good. (We need not ſay that we ſuppoſe thoſe lifts to have previouſly been made ſo ſtrong as to be able, when the tacks are got on board, to ſtand the effort which requires the heaving taught of the weather bolt-ropes, before hauling the bowlines). I have ſeen a ſhip ſo well rigged, that I cannot forbear mentioning her here as an example of what I have always conſidered as being the beſt method of rigging.

Instead of fixing two ſtrops at the head of the top-maſt to reeve the top-ſails tyes through, you make the treſtle-trees of the top-gallant croſs-trees a little thicker, and ſufficiently large to admit of a ſmall block on each ſide, in which there is a ſheave to receive the tye. That block is to be ſerved with a deal cheek rounded by the top and gouged underneath, and ſufficiently large and eaſy, that the

rope

rope which is ſtropped on the block ſhould not rub againſt the wood of the cheek as it ſlides up and down. That very wooden ſervice will be alſo as a ſupport to the rigging of the maſts heads, and prevent, at the ſame time, the water from getting to the ſaid ſmall block. By ſuch means two large blocks may very eaſily be ſuppreſſed, and nothing is ſeen at the head of the maſts.

THEN the tyes ſhould be fixed for good on the yard; and, in ſuch men of war as have but a ſmall crew, or in time of peace, you may place one block only on the yard in which the tye will be reeved, to make it run more eaſy.

IN the treſtle-trees, afore the firſt top-gallant croſs-tree, ſhould be introduced, on each ſide, a ſmall block with two ſheaves, on which ſhould be reeved the top-ſails, bunt-lines, and leech-lines; ſo that, by this operation, you would have eight blocks leſs on the top-ſtay's collars. Afore this laſt ſmall block, on the main-top-maſt treſtle-tree, you might place another with a ſingle ſheave, the uſe of which would be to receive the braces of the fore-top-gallant ſails, which thence would go back again to, and continue along, the top-maſt-ſtay as uſual. Aback the top-maſt croſs-tree which goes athwart the treſtle-trees, abaft the fore-top-maſt, muſt then be placed, on each ſide, over and upon thoſe treſtle-trees, a ſmall oblique block, with a ſingle ſheave, to receive the bowlines of the main top-gallant ſail.

THE top-gallant and top-gallant-royal tyes ſhould be reeved at the head of their reſpective maſts, in nicks cut in the knobs, and which would be contrived for that purpoſe; and, in order not to weaken the maſts too much, the main and fore-top-gallant lifts (whenever you mean to rigg any top-gallant-royal), might be reeved in ſmall blocks fixed at the head of the maſt for that purpoſe, without cutting any more nicks beſides thoſe which ſerve for the tyes.

IN order to reeve the ſtay-ſails, halliards, and ſtays, nicks with ſheaves muſt be contrived in the top-maſts caps: all kinds of mere leading

leading blocks, hitherto ufed for the top-gallant clue-lines, lifts, and fheets, fhould then alfo be fuppreffed from the fhrouds, and be fupplied by thimbles or wooden travellers.

THEN the mizen top-fail's braces fhould be brought on the tenon of the main-maft, its bow-line on the edge of the main-top, and the crofs-jack brace to the main catharpings: then the fore braces will come under the main-top and at the foot of the main-maft, and the fore-preventer braces on the gang-ways.

WHEN mafting fhall be made lower than it is now, it will be proper to fet the main-top-maft's ftays fo as not to incumber the fore-maft; which object in order to obtain, they fhould be made to go the one to the ftarboard and the other to the larboard fides of that maft, in fixing their loofened dead-eyes precifely even with the gammoning of the bowfprit, fo that they will not fatigue any of the mafts, nor the fore-ftays.

THUS have we fulfilled the main point of our object; and, as for the reft, I believe I have faid enough to make any one conceive that he may eafily find a full fcope to exercife his imagination, in diminifhing, wherever it will be practicable, both the bulk and the weight: which will certainly not be very difficult for fuch as will but give themfelves up to that interefting object, with fome fort of attention, and a fincere defire for the intrinfic benefit and advantage of the art of manœuvering.

I SHALL therefore not expatiate any longer on an article which is fo arbitrary in itfelf, that, fhould it be ever fo well, it is almoft impoffible not to find means how to do ftill better.

CHAPTER XI.

Thoughts on the method of forming feamen, and on regulating the feveral duties of the officers and crew at fea.

IN all fhips of war the fervice is diftributed; but, as the King's Statutes concerning the Marine do not prefcribe any thing particular concerning

concerning the distribution of that service, the Captains dispose of this matter as they think fit, which is generally according to the established custom. It might however be worthy of our consideration, to try whether the common practice is not susceptible of improvement.

I HAVE not the presumption to imagine myself capable of giving decisive principles on a subject, which would require in the writer more knowledge of the great art of governing mankind than I pretend to have. Therefore, I must solicit my Reader's indulgence for what I shall venture to advance in this Chapter, where I offer my reflections on a subject which may be looked upon as the first talent necessary to every man who is to command others.

THE science of a Captain does not consist, as many would insinuate, in doing every thing himself. To flatter one's self with being able to do so is a presumption; to attempt to persuade others that one is able to do it, is another no less ridiculous pride: besides, the detail is the function and duty of the Officer next in command to the Captain who is only to direct those who act under his immediate orders, and to exact an account from those he has thought proper to employ, according to their capacity. If those who affect to inspect every thing with their own eyes, and visit every quarter, were thoroughly convinced of this truth, that "a mind fitted to "descend to the minutiæ of business is only qualified for a subor-"dinate rank;" I make no doubt pride and self-love would restrain them, and they would find their vanity more fully gratified by observing a different conduct; for, it is nothing but their vanity which prompts them to this frequent appearance, persuaded that the oftener they are seen, the greater authority and respect they shall acquire from their inferiors; a most egregious error, which shews evidently they never had any idea of what a celebrated Author observes, "that the true genius in the art of commanding is he "who, without any mechanical operation of his hand, gets every "thing done; who reflects, disposes, plans, directs, and is careful

"to leave nothing to the power of chance; whose principal attention "is to have a thorough knowledge of the talents of those who act "under him, in order to employ them usefully in the execution of "his designs."

The conduct of a Captain, at sea, should be calculated to inspire the ship's crew with a confidence in the officers placed over them. He himself should therefore appear as seldom as possible, unless on general occasions; for example: he should always be present at all the exercises of naval evolutions; all the anchorings and getting under way; in chases and engagements; in a word, at all times when respect is to be inspired, and the manœuvres require dispatch. But in all other ordinary matters, such as reefing, diminishing or increasing the quantity of sail to be carried, according to the weather; changing course, and winding about, &c, during the time of a passage; all this, I say, should be executed by the Lieutenant, and the Captain should have no farther concern in all this business, than so far as it relates to the orders he may have given him. By these means the crew not being accustomed to see him but on important occasions, his appearance is then sufficient to inforce respect, and to persuade the men that the business required is essential; consequently they exert themselves with more ardour and confidence, especially as they are farther excited by the Officers dispersed in the different quarters of the ship, who, on those occasions, call forth their utmost vigour and activity.

Such regular conduct in the Captain inspires the crew with confidence in their Officers, with whom they use themselves, as they perceive they have been judged capable of the detail of business, since it has been left to them; a thing which is the most ostensible, it is true, but not, however, of great consequence. This practice forms also the Officers themselves; by exercising the crew, they acquire what is called the *coup-d'œil*, or quickness of discernment, which is of the greatest importance in the presence of an enemy: they

they learn to meaſure with more exactneſs the diſtances required between the different evolutions, and the time which each of them takes in its execution; and they become better acquainted with their own ſhip's motions. By theſe means, the number of Officers ſkilled in the art of manœuvering is conſiderably increaſed: but, on the other hand, unhappy is the Officer who happens to fall under an improper diſcipline; for, he then loſes much of his own knowledge, if he had any; and, ſhould he be totally ignorant at his firſt entrance upon duty under ſuch command, he will forever remain ſo, becauſe he finds no incentive to emulation.

THE moſt frequent and moſt dangerous obſtacle to the improvement of the Navy is the command, which abſorbs and haraſſes the young Officers, inſtead of forming them. It renders the ſervice diſguſting, by making it as languid as troubleſome; languid, becauſe nothing is to be done without the Captain's orders, who, by ſhewing not a ſufficient degree of confidence in his own perſon, is ſure to fill thoſe under him with fear and irreſolution. So that, whilſt they are waiting for orders, they frequently remain inactive, which is very unpleaſant to a well-informed Officer who is qualified to diſcharge his duty.

I KNOW not what could induce the greater part of our Sea-Commanders, to regulate the duties of the Officer under them in ſuch a manner as to leave him very little time for profeſſional ſtudy, when off duty. Would it not be the fear of ſeeing the common practice laid open, and the prejudice which ſupports it overcome by the knowledge of more rational principles? If that is the caſe, I muſt allow this fear is not ſo ill founded, in many reſpects: for, how much ignorance would then be expoſed! how many erroneous principles would be deſtroyed, through a practice enlightened by the ſimpleſt theory!

As I think differently from the Commanders, and other Officers who adhere to the mechanical routine, of whom there is a very con-

ſiderable number in the Navy, I venture to oppoſe this general obſtinacy; and I inſiſt that, in any ſhip where the formation of Officers for the ſervice of the State ſhall be at heart, every one of thoſe who compoſe the body of Officers of that ſhip, ſhould mount five guards at ſea, which are called watches, in order to qualify themſelves for the command, by being frequently expoſed to ſee and to practiſe what part of the ſervice they ſhall have theoretically before ſtudied and conſidered in the intervals from duty. From this diſtribution of the watches, there would reſult other advantages, which are, that the Officer having more reſt, would be more capable to ſet up and paſs the whole night on watch duty, when ſuch circumſtances require it, as bad weather, or the appearance of an enemy; on which occaſion the Officers of the watch might be doubled or kept upon duty: for, it is upon them that every thing depends on thoſe inſtants, when they are, more rigorouſly than ever, reſponſible to the Commander, for whatever may happen, by keeping an eye ſtill more vigilant over the ſentries, and on the execution of the manœuvres; whereas the labouring part of the crew, diſperſed about in the different quarters of the ſhip, may ſnatch ſome moments of repoſe one way or another upon the deck, and recruit their ſtrength, which is frequently exhauſted by labour and bad weather, to which they are more immediately expoſed than the Officer who commands them, and who is to direct the ſailors in the execution of the different manœuvres.

Not that I mean to exempt the Officer from all manual labour on thoſe melancholy occaſions, which but too frequently happen when he is under the neceſſity of acting the part both of a ſeaman and of an Officer. I am only ſpeaking here of the ſituation of a new fitted ſhip, ſailing on thoſe ordinary voyages, where ſickneſs, death, fight, and ſtormy weather, have not yet exerciſed all their deſtructive ravages. It is, therefore, in this ſituation of health and vigour, that activity is to be excited and cheriſhed, regularity and emulation promoted.

promoted. Ease and comfort even, I say, is to be procured to the Officer, and confidence inspired to him, that, in case of necessity, he may be the more able to resist any future fatigue; and he should be exhorted, and even obliged, to apply himself to professional study, should he not be naturally so disposed.

OFFICERS are all subordinate one to another on service; so that there never is, nor can be, any equality among them. Thus the inferior must always obey the superior, and the latter is answerable for the duty of the former. Nevertheless, with submission to better judgement, I imagine that the inferior Officer who commands the watch should be considered, by the Officer above him, as a sentry who cannot be released from his post until his duty is over, or by a direct order from the Captain, from whom he derives the authority of his command, when at the head of his guard. So that the superior Officer neither can, nor ought to command the manœuvre, or change the ship's course, without an order from the Captain; he cannot even move the least thing without acquainting the Officer of the watch; and the reason of this is, because the Captain is on board, and all authority, with respect to the service, is derived from him: in his absence the next in rank has the chief command, and so the rest in order,

WHEN there are two Officers on the same watch, the youngest of the two ought always to be forward at the time of any evolution, and the other ought to be on the quarter deck.

ALTHOUGH the Captain be on deck, the Officer of the watch ought to be no less exact in the execution of his duty; but, then he ought not to order any thing to be done to the sails without previously informing the Captain of his intention.

EVERY principal Officer has a right to go his round every where, at all times, and as often as he thinks proper.

IN the execution of any ordinary evolution no Warrant-Officer whatever ought to be allowed to put his hand to the manœuvre, in order

order to assist in any part of it (unless it be sometimes to shew his people the way to execute it), because he is there only to command and send every one to his post.

EVERY Warrant-Officer ought to obey, in every thing, the principal Officer, should he even have a contrary order from another Officer, to whom then he is obliged to send word immediately of what happens.

THE top-sails must not, upon any account, be suffered to be hoisted otherwise than hand-over-hand, without running and without jerk.

THE whole body, both of sailors and warrant, petty, and mechanical Officers together, is generally divided into two equal parts, in order to mount the guard or keep the watch alternately: these two divisions are distinguished by the names of starboard and larboard watches.

NOW, each watch should be divided into three other parts. The first to be composed of the pilots, their mates, and the helmsmen, whose business is to keep an eye over the rudder, the way, and the course, under the Officer of the watch, to whom they are to give an exact account. In each squadron, they shall have for additional employment, that of keeping an eye to the signals, and to every thing which concerns the navigation.

THE second part to consist of those who work on the quarter-deck, about the manœuvres to be performed both aloft and below; and to be composed of all the mechanical Officers of the watch, and other petty Officers of the manœuvre, along with sailors, and even soldiers when there are any, in order to execute whatever may be ordered by the Officer, either with respect to the working of the ship, the good of the service, or mere cleanliness.

THE third part to be composed of none but petty Officers of the manœuvre and sailors only, without any mixture of other people, but such in sufficient quantity, however, as to be able to execute all the commands which shall come from abaft forward.

THE

THE forces muſt be divided in ſuch a manner that there ſhould be no more a-head than a-ſtern, and in number proportional to the manœuvres which are to be executed at either place, and *vice verſâ*.

A DISTRIBUTION is ſuch as it ought to be, when every thing is ſo diſpoſed that the command is executed with the utmoſt alacrity. And, in order to obtain more efficaciouſly that moſt favourable diſpoſition, I think the different ſets of petty Officers of the manœuvre ſhould be particularly ſpecified, who, with a certain determined number of men, alſo named and ſpecified, were on ſuch or ſuch an occaſion to get the command executed on ſuch or ſuch rigging; ſo that, by ſuch a precaution, no more and no leſs men would ever be employed than juſt requiſite for any evolution whatever. For example, in order to brail up a lower ſail, ſo many men, once for all named beforehand, would come immediately and range on the clue-garnets to leeward; ſo many on the leech-lines, and ſo many on the bunt-lines, with one or two petty Officers pre-appointed, and who would be experienced in what is to be commanded in ſuch a caſe: the ſame diſtribution and order would be obſerved likewiſe with reſpect to the weather-brails: whatever would be determined in that matter, concerning the lower ſail, would be underſtood to be the ſame concerning the top-ſail, with a certain fixed number of men for the weather-brace; and the top-ſail would be intruſted to a particular petty Officer of the manœuvre, appointed on purpoſe for the work aloft, the others being always underſtood to be aſſigned to inſpect and command nothing but the work below. When it will be to furl the ſails, ſo many men ſhall be aſſigned for the lower, and ſo many for the top ones, with each of them their particular Officers well known.

IF you want to put or tack the ſhip about, you muſt take care to diſtribute your people with method, in placing proper petty Officers every where; appointing ſo many men to the lower ſheets, ſo many to the tacks, ſo many to each brace, ſo many to the mizen and to

the mizen top-ſail. Then, theſe men will be diſtributed afterwards about the braces and ſheets of the other ſails. Finally, whenever particular parts ſhall be allotted to any particular ſet of men, ſo as to make thereby their peculiar ſtation and employment diſtinct and conſtantly the ſame; and whenever ſuch particular allotments ſhall be rigouroufly kept up and obſerved, eſpecially in the beginning of each paſſage, you will always have the ſatisfaction to ſee afterwards every thing ranging as it were of itſelf to order, and the manœuvres will be executed not only with more method and exactneſs, but alſo with much more ſpirit: a point, all this, very eſſential to be obtained in the evolutions which are to be executed before an enemy, as well as in many difficult caſes, from which one could never be extricated without a ſingular celerity and alertneſs, which no one but a ſtudious mariner can ever be acquainted with; for, how many have been killed for want of executing their evolution with ſufficient alertneſs! How many, who have never been heard of ſince, have periſhed for want of vivacity and diſcipline!

ARTICLE I.

Of the clearing the ſhip for an engagement, or, Up all hammocks.

In this operation all the cloaths of the crew are to be diſtributed in the nettings, which are to be firmly ſeized to the iron cranes; and, when that is done, the whole is to be covered with a tarred four-threads cloth, ſo diſpoſed that, after having covered the whole with it, it may be faſtened underneath with bits of laſhings fixed in ſmall eye-let holes. Such a covering has the advantage of preſerving from rain and fire the beds and cloaths which belong to the ſailors, ſo that every thing may remain in that ſituation without inconveniency. For, in a battle, the bullets make no more than their hole, and nothing falls into the ſea: and if the wind blows ſome

ſparkles

ſparkles by ſending ſome wads in fire, they fall back and do not ſet fire to the netting.

JUST before coming out of the harbour, you will obſerve to rig, once for all,* the intervals between the ports, the tiers, and the fore-caſtle and quarter-deck, with foxes nailed on the edges, in order to deaden the ſplinters occaſioned by the bullets when they pierce the ſides of the ſhip.

IN the cable ſtage, which is under the orlop, you muſt take care to keep ſpare top-maſts and ſails, ready prepared and fitted with their points, rope-bands, earings, &c, that you may have them ready at hand when wanted, either during or after the battle.

YOU muſt have a particular care alſo to keep the orlops very ſpruce, and cable tiers quite clear at the main hatch-way, that the Surgeons and wounded may have all the room neceſſary. It is a piece of humanity which does not allow any neglect on that head.

THE wings are always, and at all times, to be kept empty and clear of every thing whatever, except the plugs or rollers of the calker, ready fitted and tallowed, to ſtop the holes made by the bullets at the water-line. You keep alſo, ready at hand, ſome leaden plates and nails, with ſtages prepared for ſuſpending the workmen without board, when the caſe requires. It is the buſineſs of the Officer who commands the lower tier to keep an eye over theſe things, and bring an account of their being all right to the Captain.

THE Boatſwain's buſineſs is to ſee all the ſpare running-ropes (which muſt be kept by double and triple ſets) properly reeved. Theſe are the braces and preventer-braces, which are to be placed afore and aback of the yards in general, ſo that there ſhould be ſix braces to every yard: the ſtoppers, which are alſo to be placed on

* Not practiſed in the Britiſh Navy.

the clews of the top-ſails, on the tyes and falſe tyes, on the ſtanding parts of the braces, ſtays, and preventer-ſtays, with puddenings under every parrel, which are to be ſtrengthened in making them double: the guys of the lower yards are alſo to be made double; and the chains which are to go round the yard muſt be placed in ſuch a manner that they ſhould not obſtruct any thing.

MOREOVER, you muſt have ready on the quarter-deck, the fore-caſtle, and the tops, ſtoppers of all kinds and denominations, hatchets, tallow, marline, blocks, and ropes ready to reeve as, and in the ſtead of, what may be cut by the ſhot.

YOU muſt put a two-inch rope along the top-ſails bolt-ropes, which is to be fixed on little tablings placed on purpoſe to receive it; it will prevent the ſail from tearing athwart, in caſe the bolt-rope ſhould be cut.*

THE boarding grapnels ſhould always be kept ready at each extremity of the yards, with their chains: many more of theſe muſt alſo be kept on the quarter-deck, fore-caſtle, and gang-ways, to throw with the hand and join better the two ſhips together. Theſe laſt grapnels ought to be very light, that they may be more eaſily handled. Some ſpare ones muſt alſo be preſerved, to ſupply thoſe of the yards, in caſe the firſt ſhould be cut down.

THE ſails not in uſe are to be rope-yarned, that they may be the more readily unfurled when wanted.

WHEN you ſhall be about fighting, in a line of battle, or in a body, you muſt take care to have ready on the quarter-deck, fore-caſtle, poop, and gang-way, ſome feruled fire-booms, light and handy, to repel the fire-ſhips: ſome others are to be placed alſo in the windows of the ward-room, and of the quarter-galleries. All theſe particulars are the concern of the petty Officer of the

manœuvre

* Not done in the Britiſh Navy.

manœuvre, who is to go and give an account of it to the Captain before the engagement begins.

Too many precautions cannot be taken against fire. Therefore, you must have a particular care that there should be nothing on the outside of the ship susceptible of catching fire; the same attention must be paid likewise to the nettings, which are to be covered as we said before. Behind each gun are to be kept in readiness two half tubs full of water, with their swabs.

THERE should be kept in every ship two fire-engines, and always in good order. I cannot conceive how, in our Navy, such a precaution could be neglected; for, it is of the utmost importance in many circumstances, either to procure water for putting out the fire, or to wet the sails in dry weather.

THE Gunner's business is to prepare, and set in order, every thing which concerns the service of the artillery. He must pay the greatest attention to see that the cartridges should not be wanting during the time of an engagement which may be lasting and warm. He is to cause to be distributed, in every post, iron cringles, to supply the deficiency of the rings and hooks which may chance to break. He is to deliver the grenades and grenade-tubs, in the tops, quarter-deck, fore-castle, poop, and gang-ways, with the matches for the grenadiers. The Gunner has also the charge* to send down in the store-rooms, and in the chests, aback and afore under the Boatswain's, those who have the charge of distributing the powder under the orders of the Captain's Clerk: then he locks the hatchways and gives the key to the Officer who commands the deck, to dispose of it according to the Captain's orders.

THE Officers of each deck are to keep a close eye to every thing; and, before the fight begins, to give an account to the Captain of

* Not in the British service.

the good order which reigns every where through the ſhip. Then the Captain is to go his round himſelf in every place, when time will permit, before the engagement, and ſay ſomething agreeable to animate the crew and engage them to do their duty with ſpirit.

The Maſter-Pilot and his mates are to prepare every thing belonging to their department, *viz.* the ſignals; the truſſes, ropes, and tackles; the ſpare tillers; the helmſmen; the ſteering tackles in the gun-room; compaſſes, glaſſes, &c. He turns the three or four-hour glaſs at the moment the engagement begins; marks the courſe when the fight is in chaſing or retreating; ſets down the time of the various events, and the circumſtances of the engagement: he watches over the helmſmen and whatever is ordered at the binacle concerning the rudder, by the Captain and the Warrant-Officer of the manœuvre, on whom he is to have continually his eye fixed, that he may not loſe the leaſt ſyllable or ſign of the command.

Afore the binacle is to ſtand conſtantly an axiometer, vulgarly called the *tell-tale of the tiller*, which is to ſhew on what board is the helm, and by how much it is either way. It is again one of the charges of the Maſter Gunner to ſee that this inſtrument is in good order, and has nothing wanting.

In caſe of any ſounding, it is proper the buckets which hold the leads, lines, and plummets, ſhould be ready to leeward of the mizen-maſt, if the fight is on one board only.

The Maſter-Carpenter's buſineſs is to viſit all the galleries and wings, in order to keep them clear and ready, ſo that, in caſe of neceſſity, he may work in them with eaſe. He will keep all the hatchets in readineſs, and diſtributed in different parts of the ſhip, and hang ſome by their laſhes to the maſts. He muſt keep alſo in readineſs all his ſpare implements, that he may inſtantly replace whatever may happen to fail.

The Calker, after having well rigged, tried, and viſited all the pumps and their ſpare ſtores, ſhall place ropes outward and all around

around the ſhip above the water-line, ſtopped with iron ſtaples, to keep one ſuſpended to them by a gird, when required, particularly about the riſings of the ſhip's floor afore and abaft, where the blows are moſt dangerous. He ſhall keep in readineſs wooden plugs, wads of oakum, tallow and aſhes, leaden plates fitted and bored ready for nailing; all theſe things are to be dealt out in different places of the ſhip, in order to have them at hand, as well as the hand baſkets, knapſacks, and cork jackets, to fling one's ſelf overboard. He and his mates are to be perpetually on the watch and liſtening, to diſtinguiſh the ſhots which come to or under the water line, in order to remedy them inſtantly.

Scuttled caſks, filled with freſh water, ſhould be carefully placed on the decks and fore-caſtle, to refreſh the crew during the fight; and, in order that no body ſhould quit his poſt to go and drink, a tub ſhould be carried about by two men appointed on purpoſe for that particular buſineſs, and who muſt go from deck to deck and from poſt to poſt.

The Maſter at Arms ſhall take care of the muſkets and piſtols, which he is to keep ready loaded and freſh primed, fit for firing. He ſhall inſpect and keep in readineſs the cutlaſſes, the battle-axes, pikes, halberds, and eſpecially every thing which concerns the ſmall arms. He ſhall deal them out about the different poſts, with the ammunition, ſuch as balls, grenade-matches, flints, and rammers: all theſe things are to be kept from accidents as much as poſſible. The ſame Maſter at Arms ſhall keep in readineſs alſo a certain quantity of ſpare cartridges, and full cartouch-caſes, fit to be delivered, in proportion as they ſhall be wanted, at the different quarters.

ARTICLE II.

Of what is to be obſerved during the engagement.

During the fight the greateſt ſilence is to be obſerved. No one ſhould quit his poſt upon pain of death. The wounded muſt be carried

carried or conducted to the Surgeon by thoſe who ſhall have been appointed by the Captain for that purpoſe. Should any one diſcover an advantage to be taken, he ſhall inform of it the Officer who ſtands neareſt to him. No kind of rigging whatever is to be touched without order. Should any dangerous ſhot be received at the water-line of the ſhip, ſuch of the calkers, or carpenters, or any other perſon as perceives it, ſhall inform, in private, the Captain with it, without ſaying a word of the ſame to any one elſe on pain of death, unleſs it be a ſuperior Officer: the ſame precautions ſhall alſo be obſerved about any part of the ſhip catching fire.

No gun is to be fired unleſs it be well loaded and levelled. It is better not to fire than to fire too raſhly and at hazard. A gun ought to be re-loaded as ſoon as fired, and none are to be left empty although one ſhould go from one ſide to the other ſide; in which caſe, three men are to be left to re-load it, and return afterwards to join their comrades. When there want people to execute the manœuvre, one may take ſome, with the Captain's orders, from the different guns, chuſing by preference thoſe who were aſſigned for boarding.

If, towards the middle of the fight, one ſhould think there are not a ſufficient quantity of cartridges and primes ready, people muſt be employed inſtantly in filling more of them in the magazines.

Should any one happen to refuſe obeying an Officer during the engagement, he ſhall be put to death on the ſpot; the ſame ſhall be done to any one who will hide himſelf or feign to be wounded.

Should one of the Enemy's ſhips, or a fire-ſhip, approach to board you, the greateſt ſilence is to be obſerved at that moment, in order to hear the commands of the manœuvre. You muſt ceaſe your firing on any other ſhip, to keep it for the veſſel who is coming up to you, and on whom you are to direct your whole broadſide loaded with bullet and caſe-ſhot. If your boats are out, as they ought to be when the weather permits, they ſhall take care to be in readineſs

readineſs to execute whatever ſhall be ordered them, in order to repel the fire-ſhips by throwing grapnels on board them to tow them off, and trying to take their guard-boats in order to prevent the retreating of their crew. Beſides, you are to try to ſink them with firing them under water, ſhould they even board you at laſt: and, if you ſee you cannot avoid catching fire, you muſt try to fling every thing you can overboard, that it may help to ſave ſomebody; then wet the powders, after having, through the main hatch-way, fired ſome ſhot from your lower deck in the hold of the fire-ſhips, to ſink them if poſſible.

WHETHER you board, or are boarded by another ſhip, you muſt take care to let fall the ports of the lower tier, to prevent any body getting in, and throwing grenades or ſetting fire to your ſhip that way: but the ports are not to be ſhut but when the guns can no longer be of uſe, by the two ſhips being ſo cloſe as to touch, as when you run along-ſide one of another.

WHETHER you are to windward or to leeward, ſailing large, ſhould you ſee the firing of your enemy decreaſing, you muſt ſeize the opportunity to board him fiercely, and take advantage of his confuſion, which can but be augmented by your attempt; then, throwing as many of your crew on board him as you can, you will undoubtedly complete his ruin.

ARTICLE III.

Of the order to be obſerved for an engagement; and of the exerciſe.

IN our ſhips, the crew, numerous as they are, are notwithſtanding weak, on account of the incapacity of the individuals: both ſailors and ſoldiers ſhould, therefore, be often exerciſed in the practice of the different manœuvres, the managing of the artillery and ſmall arms, and in the throwing of the grenades. The command of that exerciſe ought to be the ſhorteſt, cleareſt, and moſt conciſe poſſible.

Such

Such an application in training and bringing up beginners is, undoubtedly, the moſt important duty of a Commander: for, experience muſt have often ſhewn us that, between two men of war equal in crew and guns, the difference ariſing from more or leſs dexterity in the execution, and celerity in the manœuvering, as well as in the uſe of the artillery and muſketry, is ſuch that it is with very great difficulty it can be any wiſe balanced by any other circumſtance whatever. And, indeed, it is but by means of a very ſuperior fire, and as judiciouſly as ſkilfully ſerved, that we may overcome our enemy, eſpecially in the caſe of boarding, ſince it is impoſſible to force an admittance in his ſhip at any other moment but when the ſuperiority of our fire has compelled thoſe who defend her to yield.

We are not therefore to think ourſelves ſtrong becauſe we have a numerous crew, the moſt part of whom are but too often quite unexperienced: but we are to take pains in the forming and inſtructing of them, in diſpoſing them alſo in ſuch a manner that ſuch as know more ſhould teach thoſe who know leſs, and that no one ſhould be uſeleſs.

In order to come at that diſtribution of men in a crew, and to draw all the advantage poſſible from thoſe who compoſe it, this is what I think ſhould be done: every Captain of a ſhip, in time of war, ſhould, before ſtirring out of the harbour, be ready for fighting. Now, in order to enable himſelf to do it with more efficacy, he ſhould begin by making his quarter-bill, and divide all his people into four claſſes, that he may afterwards be a better judge how to make any alterations in it, and place every one in that particular ſtation where his private diſpoſition naturally calls him; which cannot be done without ſtudying and inceſſantly trying to penetrate and diſcover the true inclinations of every individual which compoſes his crew, in order, whenever the occaſion offers, to reap all the advantage poſſible of the whole.

The

THE *first* claſs ſhould be compoſed of the manœuverers.* Theſe men ought to be the moſt nimble and active, the moſt intrepid, the youngeſt, the moſt ſkilful in firing a muſket; and hence the fitteſt for boarding.

THE *second* claſs ſhould be compoſed of mature men, capable of being at the head of a poſt, and to command guns. Theſe maſters of ordnance ought to have been long exerciſed in their buſineſs, and have often ſhot at a mark; and it would be right they ſhould all be at leaſt gunners-adjutant.

THE *third* claſs ſhould be compoſed of muſketeers, who are to know how to fire with dexterity, load quickly, and every thing elſe relative to the handling of fire-arms.

THE *fourth* claſs ſhould be deſtined to fill up the vacancies, when any happen, during an engagement, and to procure the people neceſſary in the hold and the wings. This claſs ſhould abſolutely be compoſed of none but mechanical Officers: and, in ſuch ſhips as will have a great number of people, thoſe who are ſupernumerary ſhould make part of this fourth claſs, when the other three have got their full complement.

WHEN a whole crew ſhall have been thus divided into four ſuch claſſes, and the men placed in each of thoſe which were thought moſt ſuitable to their diſpoſitions; it will be very eaſy to diſtribute them afterwards in the various ſtations which are to be furniſhed with people. In order to render this diſpoſition more ſtriking, we ſhall ſuppoſe here a 74 guns ſhip,

28 of which are 36 pounders,
30 .. - .. 18 pounders,
16 .. - .. 8 pounders,

with 800 men on board.

* In the Engliſh ſervice, ſeamen.

THE *first class*, composed of manœuverers, must furnish 166 men, who are to be distributed in the various stations where they are wanted, as follows:

	Men.
On the fore-castle, including the mechanical Officers,	60
On the quarter deck, including ditto -	40
On the poop, - - - -	10
On the main-top, - - -	16
On the fore-top, - - - -	16
On the mizen-top, - -	8
On the fore-braces, including the mechanical Officers,	16
TOTAL	166

THE *second class* must furnish,

	Men.
For 14 thirty-six pounders, -	210
For 15 eighteen pounders, -	165
To carry the cartridges (younkers)	29
For 8 eight pounders, -	56
Master Gunners, walking on the tiers,	2
TOTAL	462

THE *third class*, composed of musketeers, shall furnish,

	Men.
On the fore-castle, - -	20
On the gang-way, - -	20
On the poop, -	60
TOTAL	100

THE

THE *fourth class*, composed of those who are to be distributed below, shall furnish,

	Men.
For the direction of the powder (the Captain's Clerk),	1
To the store rooms abaft and amid-ship, -	20
Ditto afore, called the Boatswain's, - -	12
Carpenters and Calkers in the wings, - -	10
At the Surgeon's birth, including the Chaplain,	12
For the distribution of arms (the Armourers and the Master at Arms), - - -	3
Spare helmsmen, for the time of action, -	4
TOTAL	62

WHEN the crew is divided in the form above specified, it will be proper to make it a point to place the Officers according to their merit, and to observe the same attention in respect to the soldiers and sailors. For, in the distribution of the various employments, a Captain is not obliged to pay any regard to rank; a consideration of this sort in a ship would be attended with too bad consequences. When preferments become the necessary consequence of seniority alone, emulation withers, and the service suffers, because an Officer for being the senior is often not better. Therefore, the only rule to be adhered to in these cases is always to appoint to the most difficult places such as are most capable to hold them.

ACCORDINGLY there must be,

	Officers.
On the fore-castle, including the second Captain,	3
On the quarter-deck, including the Captain,	4
On each tier, 5; for both, - -	10
At the flag on the poop, - - -	1
TOTAL	18

So that, in order that ſuch a ſhip ſhould be well manned, ſhe muſt mount 808 men if ſhe is to fight in a line; though, if nothing but a cannonading was expected from her, 650 might do.

RECAPITULATION.

The commiſſioned Officers, -	*Officers,*	18
Manœuverers claſs, or ſailors, -	*Men,*	166
Gunners claſs, - - - -	*Ditto,*	462
Muſketeers claſs, - -	*Ditto,*	100
Fourth claſs, - - -	*Ditto,*	62
TOTAL AMOUNT OF THE CREW,		808 *Men.*

If it be poſſible to increaſe the number of principal Officers, it muſt not be neglected, in order to be able to multiply them at the ſeveral ſtations. That a Captain may reap a greater advantage from the Officers, he ought never to fail ſpecifying the number of guns he is to command on the tier where he is placed. The Officers commanding the different decks have no other fixed birth but the whole extent of the tier intruſted to their care.

Next to theſe diſpoſitions, which are known to every ſeaman, the companies for boarding are to be formed. Theſe are to be compoſed of 50 men each, and make ſo many ſuch companies as to take up three-fourths of the crew. At their heads are to be placed Officers of ardent and intrepid diſpoſitions: each of thoſe companies are to be diſtinguiſhed one from the other, in order to raiſe emulation in them, and they muſt be excited to do well: in order to obtain all which, the firſt company ſhall be compoſed of petty Officers, and of ſuch of the ſailors as are moſt vigourous and intrepid; the ſecond ſhall conſiſt of choice ſoldiers, all nimble, briſk, and bold: this company ſhall ſupport the firſt, and fight along with it. Theſe two companies ſhall be ſupported by all the others compoſed either of ſoldiers or ſailors, drawn proportionally from

from the different quarters, ſuch as the guns, the muſketry, or the manœuvre. All theſe companies in general ought to be armed with a piſtol, a cutlaſs, and a pole-ax. The two firſt, in leaping on board, ſhall be provided with two grenades per man; and, in that circumſtance, they ſhall receive matches ready lighted, which they ſhall wear in their hats, reeved in braſs pipes as are contrived for that purpoſe.

At all times the greateſt attention muſt be paid to maintain order and diſcipline, for it is of the utmoſt conſequence to be able to keep every man at the ſtation which ſhall have been aſſigned to him. If all the individuals know how to obſerve rigorouſly the diſcipline, there will never be found any difficulty in ſtrengthening the ſtations which ſhall have ſuffered any diminution, by drawing men from thoſe which have not ſuffered ſo much; ſo that, after an engagement, one may make as good a figure as if none had been loſt, although, in fact, more than a quarter of the crew may have been diſabled. All this may eaſily be executed when there are on board able and intelligent Officers, who take care to replace the men who are wanting by ſome others from the ſtations which can beſt ſpare them. By ſuch means, every Officer acting the ſame in the department which is intruſted to him, it reſults that one is always in the beſt order poſſible, and nearly equally ſtrong at every part.

Such diſpoſitions once ſet up, and the whole crew informed of them, they muſt be made familiar with them, by frequent and repeated exerciſes, till they are perfectly trained: and, when they are ſufficiently ſo, to know, and to handle their arms with dexterity; when they are capable of executing the command with celerity and preciſion, (either in reſpect to the manœuvre, which conſiſts in throwing well with the hand the boarding grapnels, and thoſe from the yards extremities; or in reſpect to the artillery, the firing of the muſketry, and the lancing of the grenades); they are made to execute ſeveral ſham engagements, various ſorts of boardings, ſuppoſed

posed destructions of men at different stations, &c, in order to use them beforehand to the changes and variations which such events may produce in a real engagement.

At the time of exercising the crew, you must not neglect speaking to them often of boarding, in order to use them to view it without fear and in cool blood, to execute it with warmth and courage, and to consider it as rather serviceable, and an incident of greater security to themselves; for, prepossession has a great influence over the greatest part of men's actions. And, indeed, it is very true that this mode of fighting is not only more expeditious, but also, in general, less slaughterous than a cannonade, especially for those who board, and for the French Nation who have always found themselves superior in that kind of fighting.

The usual method practised for exercising the crew in the art of fighting, is extremely defective,* by the quantity of useless time which is taken up in the exercise of the great guns, and by the omitted part of the exercise in the art of throwing the grenades. In the 6th and 7th Articles of the present Chapter, I shall present my

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* The very same observation is made by Falconer, in his Marine Dictionary, at the article Exercise, where he says, "The exercise of the great guns has, "till the late war, been very complicated, and abounding with superfluities, in "our navy, *as well as all others*. The following method was then successfully "introduced by an Officer of distinguished abilities."

For the sake of a readier comparison with the method here proposed by Mr. Bourde', we shall copy that mentioned by Falconer, which consists of the fourteen following commands only:

1.	Silence.	8.	Fire.
2.	Cast loose your guns.	9.	Spunge your guns.
3.	Level your guns.	10.	Load with cartridge.
4.	Take out your tompions.	11.	Shot your guns.
5.	Run out your guns.	12.	Put in your tompions.
6.	Prime.	13.	House your guns.
7.	Point your guns.	14.	Secure your guns.

my Readers with an example of thoſe exerciſes contracted with the greateſt preciſion poſſible.

Could the great guns be ſhortened without diminiſhing their range, there would reſult many great advantages for the Marine. Firſt, one might put under ſhelter at leaſt ſome langrage and ſmall bullets; the ſpare top-maſts and yards, which one is always forced to place on the gallows, fore-caſtle, and quarter-deck, becauſe otherwiſe they would obſtruct the recoil of the guns of the ſecond tier. In the ſituation they are now placed they are elevated above the gang-ways and expoſed to all the poſſible injuries from the fight. So that, after an engagement in which one ſhall have been diſmaſted or loſt ſome yards, one is very often unable to repair the accident. I was once witneſs of the two ſpare top-maſts being cut to pieces by the muſketry: ſuch an accident could not have happened, had one been able to keep them on the tier along the ſtrakes of the coamings of the hatch-ways. Beſides, in keeping, as we do, theſe ſpare yards and top-maſts on the gallows, we cauſe the ſhip's center of gravity to riſe, and we retard her velocity, ſince ſhe carries a leſs quantity of ſails, and ſhe is more diſpoſed to incline.

Should the great guns be ſhorter, one might introduce artillery of a certain ſize on the light frigates, which are generally provided but with very light ones, on account of the uſual weight and length of the great guns.

On the large ſhips which mount 36 and 18 pounders, 36 and 24 might be introduced, and even 48: becauſe this laſt would not have more weight than the preſent cuſtomary 36, on account of the ſhortening of the pieces, which I here propoſe partly from Mr. *Dulacq*'s opinion only.

If, content with the preſent uſual ſize of the pieces, one ſhould not care to put 48 for 36, nor 36 for 24, then there would be a very great difference in weight to be obtained from the propoſed ſhortening. And, the whole of the artillery of a man of war being lighter

lighter and ſhorter, the ſervice of the great guns would become infinitely more eaſy and quicker; ſo that, even upon a ſuppoſition of equality, in every other reſpect, between the two engaged ſhips, ſhe who ſhould be provided with the ſhorteſt guns would ſoon get the better of her enemy by the ſuperiority of her firing, whence would ſoon reſult that of the combat: a truth ſo much the more grounded as it is undeniable, a ſhort piece is a great deal better and ſooner levelled than a long one.

Having all thoſe advantages in view, I have conſidered that a ſhort piece, the charge of which would be incloſed in a chamber with the bottom made like an hemiſphere, on the largeſt circle of which the touch-hole would be bored, would reach farther than another piece longer of the ſame ſize, and the touch-hole of which would be even with the bottom of the chamber: becauſe the inflammation of the charge, in a ſhort piece, would be not only greater but quicker than in a piece of the ordinary ſize; as the firſt and ſecond inſtant of the inflammation carry the fire in all the points of the maſs of powder contained in the hemiſpheric chamber. Now, as it is proved by experience that the bulk of that inflamed globe is at leaſt four thouſand times bigger than before the inflammation; it follows that the axis of its flame is about ſixteen times as great as that of the globe of powder before it was inflamed; for 16 is the cubic root moſt approaching to 4000.

"So," ſays Mr. *Dulacq*, "that if, on a very ſmooth table, you "place, on one and the ſame line, three heaps of powder of an "equal diameter, and eight times that diameter diſtant from each "other, then ſet fire to the center of the middle heap, you will "ſee that it will communicate to the right and left heaps."

There reſults from that experiment, that if the extenſion of a globe of powder reaches on each ſide a diſtance eight times the diameter of its ſphere, when it is inflamed without being confined, that extenſion will be much more conſiderable when it ſhall be oppoſed

opposed by solid surfaces which will resist its dilatation. For, the powder, which has been inflamed in the first and in the second instant, finding itself confined and not able to dilate, it will be repelled from all the points of the concave superficies which resists it by the opposition it offers to the power of extension. And, as the inflamed fluid must needs extend, it will go, in a re-acting direction, through all the intervals which exist between the grains which compose the remainder of the charge, towards the least resistance, *viz.* the air which surrounds all those divided particles. This first inflamed matter envelopes then, in the third instant of the inflammation, all the grains of powder which are contained in the space of its extension, and consequently beyond the whole quantity of powder inclosed in the chamber of the gun, such as we proposed and described it above. It is therefore evident, that if the fire inflames the powder as soon as it touches it, the whole charge must be inflamed at the same instant. " And," says again Mr. *Dulacq*, " if we consider that " each grain of powder may be compared to a balloon, which a " sudden wind inflates quickly, and in the space of time which " is taken by the inflammation of a grain of powder, so that it " should become equal to the bulk of a grain of powder inflamed " at liberty, it will appear evident that these balloons will tend, all " at the same time, to inflation; and as they cannot succeed on " account of the sides of the chamber which oppose a superior re- " sistance, they will re-act, in dilating their spring towards the " weakest side; and all of them together, with a velocity increased " in ratio of their multiplied and momentaneous re-action, will " expel the bullet from the chase, along with the column of air " which opposes their issue."

But, as the resistance of the metal of the breech has compelled the totality of the powder to inflame and to re-act towards the chase, there results from it the recoil of the gun, which will be so much the more violent, as the powder which took fire in the first moment

of the inflammation has communicated it to the inferior part of the first ſphere, and to another portion of the remaining part of the charge compriſed within the ſpace of its extenſion: ſo that, in the ſecond inſtant, the fluid is expelled with violence, ſince the greateſt part of the charge is inflamed, and the effort of the inflammation, which is nothing but an hemiſphere, could not be ſufficient to put in motion the remaining portion of the powder, the bullet, and the tompion which faſtens it.

From that delay, there reſults a greater inflammation; and it would be eaſy to demonſtrate, that the little quantity of powder which remains in its natural ſtate, gets inflamed in the chaſe by a third inſtant of operation, at the moment when the ſhot begins to ſtir: whence it follows, that the range of the gun muſt be increaſed, and the ſhot carried a great deal farther than it would, by a piece in which the inflammations would not be ſo ſtrong nor ſo quick, on account of the cylindric form which is generally given to the chamber, and the touch-hole of which is bored at the back, or farthermoſt extremity of that chamber.

From all this reaſoning are to be deduced the motives which are to determine to bore the chamber of the gun hemiſphere-like, by preference to the cylindric form, and to place the touch-hole on the great circle.

Repeated experiments having proved, in the ordinary pieces, that, to obtain their longer range, the charge of the powder muſt be proportioned, in reſpect to its weight, to the third part of that of the ſhot to be expelled by it, we ſhall adhere to that quantity of powder; as our object is not here to increaſe the range of the gun, but to preſerve only the ſame range undiminiſhed, although the piece itſelf be much ſhortened, in order to make it lighter.

Should the touch-hole be bored in ſuch a manner as to ſet the fire on the center of the axis of the charge, it is clear the inflammation of the powder with which it is compoſed, and the expulſion of the

the ſhot, would both receive an increaſe of velocity; becauſe the extenſion of the powder meeting with a greater compreſſion and precipitation at the ſame time, the inflamed balloons would ſpring looſe more in number at once in the ſame ſpace of time, and would conſequently produce a greater rapidity in that kind of action; whence their impulſion on the ſhot would be ſtronger, not only on account of the greater number of the particles of powder which would act together and at the ſame inſtant, but again on account of the multiplied elaſticity and velocity of the re-action. This reaſoning proves to a demonſtration, that a recoil much greater and much more violent muſt be the reſult of this operation, ſince there is a greater quantity of powers acting together on the concave parts of the chamber. Hence, it is eaſy to conceive that the carriage of the gun muſt be much agitated, and expoſed at laſt to be broken to pieces, by ſuch repeated efforts of the piece during an engagement. It would be then neceſſary to loſe ſomething on the range, in order to avoid an accident of that dangerous conſequence in a ſhip, where all thoſe reſources and conveniencies cannot be had which might be procured on land. Let us therefore conclude, that the touch-hole cannot be bored at a better place than on the large circle of the hemiſpheric interior cavity of the breech; becauſe, if it were placed on the center of gravity of the charge, it has been juſt demonſtrated that the recoil would be too violent.

If the communication of the touch-hole were placed directly over the farthermoſt part of the cavity, the recoil, it is true, would be much leſs, but there would be too much loſs on the range; becauſe the grains of powder at the bottom being the firſt inflamed, the greater oppoſition they meet with from the breech, obliges them to re-act towards the ſlighteſt reſiſtance: accordingly they drive before them, in proportion as they catch fire, the remaining part of the charge, in inflaming only but a portion of it, the effort of which, being ſuperior to the reſiſtance of the ſhot and the tompion, expels

both from the chaſe before the whole is totally inflamed. This will appear evident, if we conſider that, when the fire communicates to the charge by the breech-ſide, it inflames the remaining part but by that one end only; when, on the contrary, if it communicate nearer the center of gravity, it inflames both ends at once: therefore it has been preferred to loſe on the range, rather than to be expoſed to an accident.

We hope we have ſufficiently demonſtrated, that the hemiſpheric form of the chamber of the propoſed great gun, may produce the effect we wiſh for, *viz.* a more copious and a quicker inflammation. Now we are going to enter upon the range of the piece, to which we allow but 12 calibers in the length of the chaſe to contain the powder, the ſhot, the langrage, and the wads which are put over the charge; becauſe we have demonſtrated, that the powder which fills up the chamber is almoſt all inflamed when the ſhot begins to ſtir, and is quite ſo when it comes out of the chaſe. It is then evident that, if the piece were longer, the moving power ceaſing to act as ſoon as the powder is conſumed, the friction and jolting of the ſhot againſt the exceeding part of the length of the gun, would diminiſh the range. Beſides, the remaining part of the powder which follows the ſhot, completing its inflammation, when the flame of that which began to kindle is, after a ſufficient dilatation, juſt extinguiſhed; and after the air, at firſt rarefied, is deadened on that ſide (ſince the ſhot, by yielding to its effort, has left it all the neceſſary room for extenſion), the ſhot can no longer receive any impulſion but from the remaining part of the powder by which it is followed immediately; but this portion of powder expels it only with a very faint force, ſince it has the opportunity of re-acting towards the vacuum which exiſts now between the ſhot and the breech, in ſuch a manner that, were the piece to be longer, all moving power ceaſing to act, the velocity which the moveable body would have acquired by the impulſion of the powder in its various ſtages of inflammation,

would

would be employed partly in driving off the column of air which would resist it still in the remaining part of the piece's chase, which would be again an additional and considerable cause of the diminution in the range. Therefore, there is an absolute necessity of shortening the gun, and to allow it but just the length which is necessary for the powder of its common charge to complete its inflammation precisely at the moment the shot quits the mouth of the gun.

They use, in the navy, all sorts of pieces of artillery, from 4 to 48 pounders inclusively. Those great guns are distributed on the ships conformably to their size and strength. They are set on four-wheel carriages, the shape of which need no detail, as it is sufficiently known to sea-faring men. The best carriages are those which are sloped underneath, because they are the lighter.

The English have invented a kind of carriage more advantageous than any other, in so much as the upper part turns along with the two cheeks on a pivot, and as a single man may alone level a gun from right to left. Although a carriage of such a construction be much heavier than the others, it would not however be very difficult, in adopting the contrivance, to give it more lightness.

ARTICLE IV.

Of the exercise of the great guns.

The Cannoneers having repaired to their quarters in a sufficient number to manage well each gun, they are to be made to obey the command in giving a silent attention to it.

1st Command.——*Cast loose aprons and tackles.*

Execution.—This command is executed by the Captain of the gun, who loosens the apron, and by two other men, who also cast loose, both together, the lashing tackles on each side of the piece,

piece, laying their falls on the deck, ready to be overhauled by the recoil of the gun after firing.

2d COMMAND.——*Uncover the vent.*

EXECUTION.—THE Captain of the gun takes off the leaden apron which is on the vent, and places it more forward on the gun, ſo that it may not obſtruct the priming.

3d COMMAND.——*Prick the cartridge.*

EXECUTION.—THE Captain of the gun takes the wire with his right hand, and introduces it into the vent of the gun, forcing it on the cartridge, and makes it go up and down two or three times, in order to be certain that it is broken.

4th COMMAND.——*Prime.*

EXECUTION.—THE Captain of the gun takes the powder-horn with his left hand, after having opened it, and pours ſome powder on the vent, in which he makes it go down with the priming-wire; obſerving, at the ſame time, not to cram it too hard. When the vent is full, the ſcore which leads to the pan is to be filled alſo with powder; or, when there is no pan, a train of gun-powder is to be made from the vent to the baſe-ring and ogee; then this part of the priming is to be bruiſed with the horn.

5th COMMAND.——*Point your guns.*

EXECUTION.—THE Captain of the gun, and all thoſe who are to handle the crows and hand-ſpikes, take each their ſtation: then the former takes off the apron from the gun, that it may not obſtruct the pointing.

6th COMMAND.——*Cannoneers! point forwards.*

EXECUTION.—THE Captain of the gun orders the breech of the gun to be heaved down aft; or, he turns it ſo himſelf, if the gun is mounted on a carriage with a pivot.

*6th COMMAND.——*Point aft.*

EXECUTION.—THE Captain of the gun orders the breech to be heaved forwards, till the muzzle comes in a line with the object on which it is to fire.

**6th

**6th COMMAND.——*Point a-beam.*

N. B. *This is the best method of firing at sea; because the object is always taken by its middle, especially if you use your cannoneers to take always the midship for their mark.*

EXECUTION.—THIS command is to inform the Captain of the gun, that he is to fire abreast his ship: he executes it by placing his gun straight in the middle of the port, and pointing to the upper works of the adversary.

*** 6th COMMAND.——*Point for sinking.*

EXECUTION.—THE Captain of the gun raises the breech so as to be able to fire the shot below the water line of the ship on which he fires. When that way of firing is executed, it is proper to be very close to the enemy, in order not to lose the shot.

7th COMMAND.——*Fire.*

EXECUTION.—HE who is to execute this command, steps to the left side of the gun, holding with his right hand the match; and, as soon as the Captain of the gun has finished pointing it, he sets fire to it himself, if the gun has a lock, or he gets it done quickly by him who has that office.

8th COMMAND.—*Fix the crow before the trucks, and fasten the train-tackles.*

EXECUTION.—ONE of the men places the crow under the fore truck of the carriage after the gun has sufficiently recoiled, while others haul taught the train-tackle, and seize it in making with the falls an half-hitch over the inner block.

9th COMMAND.——*Traverse the gun.*

EXECUTION.—THIS movement is done to procure ease to the man who loads the gun; and is executed in placing the muzzle of the gun almost on one side of the port: this command may be very easily executed with the new kind of carriage we have mentioned before; for, then the gun might be loaded absolutely on the inside of the ship, and under the cover of the ship's side.

10th

10th COMMAND.——*Ram down the ſpunge.*

EXECUTION.—THE loader takes the ſpunge and rams it down to the bottom of the chamber, while the Captain of the gun holds his thumb on the vent, in order to extinguiſh the fire which might have remained at the bottom of the cartridge in the bore of the gun.

11th COMMAND.——*Draw back the ſpunge.*

EXECUTION.—THE loader turns round quickly the ſpunge in the chamber of the gun, and then draws it back, continuing to turn it.

12th COMMAND.——*Put in the cartridge and wad.*

EXECUTION.—ONE of the men, who has the charge of keeping the cartridge boxes, introduces the cartridge into the gun, and the loader places over it a wad; it is to be obſerved, that when the cartridge is taken out of the box, it muſt be done very near the mouth of the gun.

13th COMMAND.——*Ram down the charge.*

EXECUTION.—THE loader, who, during the execution of the laſt command, has quitted* the ſpunge to take the rammer, puſhes down with it the charge into the chamber of the gun, and ſtrikes it ſtrong enough to make himſelf ſure that it is home, which is proved by the priming-wire which the Captain of the gun introduces through the vent, in order to feel the cartridge; and when he is ſure of it, the rammer is drawn out.

14th

* In the Britiſh Navy, the ſpunge and the rammer are but one and the ſame rod, at one of the ends of which the ſpunge is fixed, while the other ſerves to ram down the charge: ſo that, without any loſs of time, the loader, after having ſpunged the gun, only turns the rod, and is ready prepared to ram down the cartridge with the other end, which he executes with the greateſt celerity, as ſoon as the man has placed it, with the wad fixed to it, at the entrance of the gun's muzzle.——TRANSLATOR.

14th COMMAND.——*Shot and wad your gun.*

EXECUTION.—ONE of the men introduces the ſhot a little way into the gun, and the loader places the wad over it which he has received from another; then he rams it down home to the powder with a ſtroke, and draws back the rammer.

15th COMMAND.—*Range yourſelf to the tackles, to run out the guns.*

EXECUTION.—THE Captain of the gun ranges his men equally on each ſide of the piece, along the tackle-falls, which are to haul and ſecure the gun to its port; and, immediately after, he puts the breech on the axle-tree, that it may not be cumberſome.

16th COMMAND.——*Run out your guns.*

EXECUTION.—THE crow is to be taken out from afore the trucks, and every man hauls while another eaſes the half-hitch of the train-tackle; and the Captain of the gun directs, from aback, his gun ſtraight through the middle of the port.

17th COMMAND.—*Cover the vent, and make faſt apron and tackles.*

EXECUTION.—THE Captain of the gun covers the vent with the apron; then, two men make each a turn and a hitch round the pomiglion with each of the tackle-falls, and reeve the bight between the gun and the taught tackle; after which the Captain of the gun faſtens the apron on the tackle-falls which are on each ſide of the gun, in making a knot over the middle of the apron.

ARTICLE V.

Obſervations on the exerciſe of the great guns.

WHEN the guns have got muſket locks, you muſt abſolutely take care, after every firing, to wipe the upper and under part both of the flint and of the pan.

IT would be better to make uſe of tubes in lieu of common priming: the firing would be much quicker, becauſe one would

always take care to pierce* the cartridge before trusting the tube into the vent; and, in that case, a train only of gunpowder might be made from the vent to the pan.

My opinion is, one should never make use of bar-shot, flail, nor of any other thing of this kind; because a bar-shot never does much injury in the upper works. I had rather make use of a round shot, because wherever it strikes it gets in much more easily than any other, and weakens therefore, so much the more, the strength of the wood; besides, the splinters occasioned by it destroy often a great many people.

I should wish likewise no other langrage was made use of but grape-shot, formed with small bullets, of two, one, or half a pound weight, according to the caliber of the guns. This may be fired at a quarter or a third part of a common range. When the two ships are near, and within pistol shot, I should have the guns charged with small bags of canvas filled with leaden two-ounce balls, and always, besides, a shot of the caliber of the piece.

When musket-locks are fixed to guns, they are set in a wooden stock, in the same manner as they would for a musket. To that stock they are made fast with two good screws, the heads of which are either on the outside or inside of the stock, but so well let in, however, as not to exceed the superficies of the wood, because they would prevent this stock from joining quite close to the gun, which must be very carefully guarded against; for, should there fall any powder between the stock and the gun, when it is priming, there would be a danger of blowing up that machinery. From the pan of the lock to a quarter of an inch of the vent, there must be a brass channel, to convey the fire to the charge by means of a train of powder

* The tubes used in the British Navy are so contrived as to be sufficiently peaked at their end, for pricking the cartridge at the same instant as they are trusted into the vent.——Translator.

powder which will fill it. That channel must be bent in the inside of the stock on which it will be mounted, so that the pan should join it exactly, without there being any possibility for a grain of powder to drop between them.

THERE is to be a mortice in the stock through which is to pass the trigger, which is to be fixed in that mortice, at the collar of the two perpendicular branches which compose it, by a little round pin, on which it will turn, to make the cock go when you want to fire.

A LINE should be fastened to the vertical branch of the trigger, that the pointer may the more easily fire from aback the piece, without stirring, or having any thing to fear from the recoil.

THE objections which might be made against the use of locks applied to the great guns, fall of themselves to the ground, by the experiments we have seen in trying them. They are mounted, as we said before, on a concave piece of wood fitted to the piece, and long enough for one of its extremities to be even with the after-part of the breech of the gun, and made secure to the pamiglion with a lashing, and the other extremity fastened round the cylinder of your metal, at about eight inches forward from the vent, with lashings of the same size as that abaft.

THE depth of the stock must be such that the fire-lock may be incrustated in it easily; and its thickness ought to be of three inches or thereabouts.

ARTICLE VI.

Exercise for throwing grenades.

1st COMMAND.—*Take up the grenade.*

EXECUTION.—THIS command is executed by taking the grenade with the right hand, so that the fuse should be upwards between the thumb and the fore finger.

2d COMMAND.—*Uncap the fuſe.*

EXECUTION.—AT this command the paper which covers the fuſe is torn off with the left hand.

3d COMMAND.—*Take the match.*

EXECUTION.—THIS movement is again executed with the left hand, by taking the match, which ought to be lighted in a braſs pipe, and fixed to the hat with the lighted end behind. It muſt be put out immediately after uſing.

4th COMMAND.—*Fire the fuſe.*

EXECUTION.—THE fire is put to the prime with the match; and, as ſoon as it is well lighted, the grenade is to be thrown with all the ſtrength of the arm, in ſuch a direction as to fall where intended. The fuſe muſt be neither too long nor too ſhort.

THIS exerciſe is neither long nor difficult; nor indeed is any thing which may ſerve for the inſtruction of the crew. Such exerciſes are therefore not to be neglected; and to be well executed, they require but a common ſhare of underſtanding. But, thoſe who execute the command beſt, and who ſhew the greateſt diſpoſition to do well, are to be noticed and rewarded, which will inſpire the one with emulation, and the other with jealouſy. In order to uſe more eaſily, thoſe who are intended for throwing grenades, to this exerciſe, they ſhould in the beginning be made to throw ſome not loaded, and only with primed fuſes: and, when they are found to ſucceed according to wiſh, they ſhould have ſome papier-maſhee grenades charged, which they are to practice throwing as they did the former. If they throw theſe with dexterity and boldneſs, they may then be tried to throw ſome iron ones in the ſame manner, and to make ſome burſt: if that trial ſucceeds likewiſe as well as in the precedent exerciſes, there is ſome likelihood of having got good grenadiers.

As this kind of fire is of material conſequence in boarding, where it cannot be too much multiplied, it is abſolutely neceſſary that the whole crew ſhould be uſed to the exerciſe of throwing grenades.

IF

If, in all the exercises of the manœuvre of the canon, and of the handling of the other fire-arms, a Captain shews resolution, ability, equity in rewarding merit and punishing indolence, it is likely he will not be long before he acquires the confidence of his crew: and hardly so much as that is wanting to make bright strokes. This should be a very powerful reason to excite, in that respect, the emulation of the principal Commanders, could they be well persuaded of it.

The security and the negligence of the Captains is the true cause why our crews are not so good as they might be made: for, they fail not on the side of courage; the *Barth*, the *Duguay-Trouin*, and many more, have proved it enough to all Europe; and it has been proved also in all the circumstances, where they have been commanded by men who knew how to excite their emulation.

We think it our duty to repeat here an observation of Marshal *Saxe*, who knew so well how to conduct men. "A continual "exercise makes good soldiers" (and good sailors), "because it "fills them with ideas relative to their situation, and teaches them "to despise danger, as it makes them familiar with trouble and "labour. The transition from fatigue to rest enervates them: it "offers comparative points which it is difficult to join, without "occasioning that so common and so powerful passion incumbent on "man, idleness, to grow, without inciting murmur, and weakening the soul after having weakened the body."

To this reflection I shall add another. During the peace the Royal Navy remain inactive; while the mercantile marine trades quietly without any warlike idea. So that, after a peace of some duration, the State possesses, it is true, good sailors, but such sailors as have not the least idea of what is to be done in a ship of war; they know not even the arms which are used in such a circumstance. Now, since merchant-ships are those which form the sailors, they should

ſhould then exerciſe them in the handling of arms alſo : and every ſhip which goes to ſea, ſhould make it a point of cuſtom to practice twice a week *up all hammocks*, and the exerciſe, be the weather whatever it would. This would coſt nothing, and would compleat the training of the crews, by offering them inceſſantly an idea of war, which is analogous enough with the rough diſpoſitions of a ſea-faring man.

ARTICLE VII.

Obſervations on the attack.

Before attacking, every Frenchman ought to be perſuaded that it is neceſſary for him to combat very cloſe, becauſe the vivacity of the Nation makes her always ſuperior in muſketry, and, beſides, one is more able to take the advantage of boarding when the opportunity offers; an occaſion which never ought to be neglected, but, on the contrary, ſought for, becauſe the ardour of fighting and the *coup-de-main* are the peculiar characteriſtics of the Frenchman. Whenever, therefore, an occaſion for fighting ſhall offer, it will be neceſſary to make every thing ready for boarding; and the way of doing it with ſucceſs is to ſpeak conſtantly of it to the crew, and to excite them to it by the hope and attraction of plunder, which muſt be allowed to a certain degree, though with moderation, whenever you happen to take poſſeſſion of a ſhip by that always deciſive and never failing method.

Another conſideration is, that it is always advantageous to be the aſſailant, becauſe it makes the adverſary ſuppoſe you have nothing to fear; therefore it fills him with terror and your crew with confidence, both at the ſame time. For, generally, when you attack, it is conformably to a plan you have formed to yourſelf, and which your adverſary can ſeldom gueſs at but in the courſe

of

of the engagement; and then it may be too late to try to break measures which have been thus premeditated.

WHEN a Commander is going to attack a ſhip, he muſt not be wholly taken up with his project of attack or manœuvre: he muſt alſo think of and guard himſelf againſt all the ſurpriſes of manœuvre which his enemy might attempt, and judge, by the poſition where his adverſary is, of all thoſe he might try in order to draw him into ſome ſnare, or to avoid thoſe he might lay out for him, and not to loſe at the ſame time his principal object in view; for it is a point which he muſt not loſe ſight of, whatever may be the ſituation he is in.

I SHOULD not be of opinion to receive the firſt fire of an enemy, unleſs it be at a diſtance: for, when cloſe to each other, the firſt broadſide is always the moſt dreadful. It may ſtrip you of very eſſential rigging, kill a great many of your crew, and expoſe you thereby to ſurrender for mere want of being able to manœuver. The greateſt advantage is then moſt certainly for him who fires firſt WHEN CLOSE TO EACH OTHER; for, if you are but tolerable markſmen, you diſable partly your adverſary, you kill many of his people, very often you ſtun him, and the broadſide which he returns is ſeldom well pointed.

IF the ſhip you are attacking pops and pops again at a diſtance, let him do ſo without return; for he will never cauſe you much damage that way: but, you muſt manœuver ſo as to approach him as faſt as you poſſibly can, that you may ſtun him by a fire well ſerved, and ſalute faſhion, that is to ſay with ſhot fired quickly one after another and well pointed.

WHEN you come to boarding, no one is to be ſuffered to leap on board before the fire of the muſketry and grenades has made the enemy abandon the fore-caſtle, quarter-deck, and poop: and when you ſee your adverſary begin to yield or be frighted, you redouble your efforts, and then let go boldly on board thoſe who were deſtined

for

for boarding, provided however you ſee they may paſs in a ſufficient number together to ſtand on and make a good reſiſtance to the repulſe they muſt expect to meet with.

When you fight in line, or ſingly, you muſt be well perſuaded that the moſt dangerous thing is to yield, ſhould it be ever ſo little; becauſe, on the one hand, this motion emboldens your adverſary, who, in ſuch a caſe, redoubles generally the vivacity of his fire; while on the other, your crew ſlacken, and loſe their ſpirit and confidence; your fire diminiſhes, and your people always imagine that your caſe is of a more dangerous conſequence than often it is; for, the leaſt act of timidity or intrepidity in a Captain influences powerfully the diſpoſitions of his crew, either for the worſt or for the beſt.

This is the place for propoſing an idea, the putting of which into execution ſeems to me of very great importance, could it be admitted. Every one allows that a Captain is the ſoul of his ſhip: the whole crew fix their eyes upon him and examine him in all the perilous circumſtances. He alone is the true mover of the actions of each individual, eſpecially in an engagement, when every thing good or bad is charged to his account. It would therefore, methinks, be very eſſential that ſuch a principal man at leaſt ſhould be a little more ſheltered againſt the blows than any other Officer or ſoldier who has nothing but his own perſon to anſwer for, and whoſe loſs is not of ſo dangerous tendency for the remainder of the crew. I could then wiſh that the Captains of ſhips ſhould, during an engagement, be covered with a good armour muſket-proof, which would be a great advantage, for they would then have hardly any thing elſe to fear but the great ſhot. This armour could not be cumberſome to them, becauſe they are not expoſed to leap on board the adverſary as thoſe of the crew who are under their command; they are bound never to quit the deck on which they are acting, and they are not to go from one place to the other: thus, an armour could

could not hinder a Captain from executing with eafe all the motions neceffary in the courfe of an engagement. The utility and advantages refulting from fuch a precaution can therefore not be denied; for, how frequently have fhips been taken, who never would, had not the Captains been killed, and had not their death filled the crew with difmay and confufion! And, indeed, it muft be allowed that, in fuch a circumftance, a general difcouragement feizes on the minds of all the crew, who no longer make any but falfe manœuvres; the fire is badly ferved, and the end is always a furrender. After all, it is lefs for one's felf than for others and the State, that a Captain is bound to take care of himfelf: therefore, he fhould not be afhamed of wearing armour; for he muft before have given fufficient proofs, when he was a fubordinate Officer, that fear is not the motive which induces him now to think of his prefervation. Prejudice fhould not then prevail here againft reafon fupported by the motive of public good.

CHAPTER XII.

How to brail up a top-fail and a lower-fail in ftrefs of weather; with the method of fetting them.

IN order to clew up a top-fail in ftrefs of weather, with the wind either large or clofe hauled, without running the rifk of fplitting it, you muft lay hold of the weather brace and faften it very taught, without loofening the bow-line, which is to be made faft as foon as the top-fail is on the cap; next to this, you range your people on the two bunt-lines, the leech-line, and the weather clue-line, which is to be made faft, in loofening on the weather fide: then, all the failors acting with ftrength on all the brails, you eafe off the bow-line, and when the clue-line is up on the weather fide, you call the failors who were on that fide, as well as thofe of the leech-lines,

to the leeward ſide; and when they are ranged on the leeward brails, you looſen the ſheet on that ſide, and haul all up as quick as poſſible, that you may after that be able to brace the top-ſail taperly, that is to ſay, on the parallel to the direction of the wind, in order to furl it more eaſily. This mode of clewing up is certainly the beſt, the quickeſt, and the ſafeſt, whatever may be ſaid to the contrary by thoſe who know no other rule but cuſtom, and who are not therefore ſenſible of the phyſical cauſe of this operation, which we hope we have ſufficiently made evident and clear, when we ſpoke of the natural tendency the ſails have to range themſelves perpendicularly to the direction of the fluid.

WHEN, in ſtreſs of weather, you find yourſelf obliged to ſet a top-ſail, you muſt firſt begin to haul home the lee ſheet, after having braced the yard ſo as the ſail may take the wind in; and, when that ſheet is home, you will paſs to the weather ſide, where you will do the ſame. This method is grounded on the ſame principle as the preceding one in brailing it up.

WHEN you wiſh to brail up a lower-ſail, the lee-clue garnet, as well as the leech-line and bunt-line, are to be brailed up firſt; and when that clue ſhall be up, you will paſs to that of the weather ſide, and haul up the weather-clue of the main-ſail: a little while after you will eaſe off the bow-line, and haul in the weather brace, in order to prevent the ſail from fixing itſelf on the ſtay; and the brails ſhall be in the mean while hauled up as faſt as poſſible; for all kinds of manœuvres ought always to be executed with quickneſs and celerity. When, in ſtreſs of weather, you want to ſet a lower-ſail, you muſt begin by hauling its tack aboard, eaſing away at the ſame time the weather brace, in order to keep the ſail ſhivering: then immediately after, you will make it faſt; but, let it ſuffice to ſay, that the method of ſetting a lower-ſail is exactly the contrary of what is done in the ſame circumſtance to ſet a top-ſail; which difference ariſes from the diſpoſitions of things, and from the riggings, which are alſo very different.

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The execution of moſt of the manœuvres which are practiſed in a ſhip, either for the diſpoſition of the cables, the effects of the capſtern in heaving up the anchors, or getting in or out the boats; to bend ſails to their yards; take-in reefs; rig the top-gallant-yards, or maſts; put tops to them, or take them off; ſet up ſhrouds, and many other things of this nature; all this, I ſay, will be much better and much ſooner learnt in the courſe of a voyage, than by all that could be ſaid here to give an idea of them. All theſe operations are ſo merely practical, that they muſt abſolutely be ſeen performed in order to be well conceived and underſtood. One ſingle voyage will therefore inſtruct better, in that reſpect, than all that could be written on the ſubject.

END OF THE THIRD PART.

AN

ESSAY

ON

NAVAL TACTICS.

PART THE FOURTH.

On Naval Evolutions.

THIS part of the Manœuvre properly concerns the commanding Officer ſailing at the head of a ſquadron or of a fleet. It may be conſidered as a natural continuation of the evolutions of a ſingle ſhip, ſince it is not poſſible to be a good Commander without being previouſly maſter both of the theory and practice of the movements of every ſingle ſhip in particular.

THE Naval Evolutions have been ſo compleatly treated of towards the end of the laſt century by Father HOSTE, that we may with juſtice declare he has exhauſted the ſubject in the very firſt attempt. Many ſince have, notwithſtanding, undertaken to write on the ſame matter, among whom in particular is to be reckoned Mr. BIGOT DEMOROGUES, Captain in the King's Navy, who has juſt publiſhed an excellent Work on EVOLUTIONS and SIGNALS. Theſe learned Authors, in writing on Naval Tactics, have all contented themſelves with deſcanting very minutely on the various orders

orders of ſailing of a whole fleet; but none of them have ſufficiently defined that which I would propoſe for the common order of ſailing, I mean the ORDER of CONVOY; as this order appears to me the moſt ſimple and the only one a fleet ought to be in at all times; becauſe, firſt, this order is eaſily preſerved; ſecondly, it cannot be diſcompoſed in twenty out of the thirty-two ſhifts of wind, and is eaſily re-eſtabliſhed in the twelve other changes; finally, it is eaſy to paſs from that order to thoſe proper for the ſecurity of a fleet, in all poſſible caſes, either to preſerve one's ſelf, to attack, or to defend. This is therefore what we are going to endeavour to demonſtrate in this fourth part of our Work. As for the movements of a fleet in the five orders of ſailing, as well as for the changes of ſquadrons in thoſe various orders, we refer to the Treatiſes of Father HOSTE and Mr. DEMOROGUES, contenting ourſelves with ſpeaking of that only which ſeems to us eſſential, and practicable in all kinds of events.

To facilitate the underſtanding of what we have to ſay, we ſhall give the definitions and figures only of the different orders; and dwell upon nothing more than a few particulars which are relative to the three ORDERS, of CONVOY, of BATTLE, and of RETREAT, that we may ſhow young Officers how it is poſſible to paſs from the two laſt-mentioned orders to the firſt which we propoſe, and *vice verſâ*; which will reduce NAVAL TACTICS to the greateſt ſimplicity.

CHAPTER I.

Of the manner of dividing fleets; with obſervations to render it eaſily practicable.

FLEETS, however numerous, ought to be divided into three ſquadrons or diviſions; and theſe again may be ſubdivided according as the ſervice requires; as, for example, when it is found neceſſary

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to form a detachment of the beſt-ſailing ſhips, either to obſerve the enemy cloſely, to bring him ſooner to action, to diſturb him in his order of ſailing, or to come up with him in a ſuperior number, in order to deſtroy him more eaſily; as again, when, at other times, a certain number is wanted to guard the entrance of a port, or keep the ſea to obſerve what paſſes in the offing.

When the fleet is divided into ſquadrons, each of them has a commanding Officer. The firſt ſquadron, which forms the center diviſion in the order of battle, ought, when the ſailing is divided in three files or columns, to keep its poſt between the two others. The ſecond ſquadron ought, in that caſe, to form the ſtarboard column; and, in the line of battle, is to keep the van or the rear, according to the Admiral's orders, or as circumſtances may require. Then the third ſquadron is to form the larboard column; but, ſhould the three ſquadrons ſail together in two files or columns, that which is the third is to be divided equally between the other two; and when the ſecond ſquadron leads, the third is to be in the rear, ſo that they never can intermix, but always keep diſtinct from one another in the order of battle.

The firſt ſquadron, which is commanded by the Admiral himſelf, ought to carry the mark of diſtinction at the main top-gallant maſt head, where the firſt Admiral carries his own flag or broad pendant; and all the ſhips of that ſquadron are to have common pendants at the ſame place without a vane.

The ſecond ſquadron is to carry the diſtinguiſhing mark at the fore top-gallant maſt head, where the ſecond or Rear-Admiral carries his own broad pendant; and all the ſhips under his command are to have common pendants at the ſame maſt's head, but without vanes.

The third ſquadron, in ſhort, is to carry the mark of diſtinction at the mizen top-gallant maſt head, in the ſame form and manner as has been explained of the two former ſquadrons.

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The three squadrons of a fleet ought to be equal in point of numbers; and the ships stronger or weaker, large or small, ought to be distributed equally throughout the three squadrons, in order that the one may be able to oppose the enemy as effectually as the other. For, in certain cases, it will happen so that such squadron as was to have the van will needs be forced to be placed in the rear; and when the squadrons are of the same strength, their stations become indifferent, and fewer evolutions are consequently required; which is always a great advantage in presence of the enemy. The sloops, fire-ships, hospital-ships, victuallers, and store-ships, are to be posted to windward of the fleet; because, in that position, they can easily veer on the ships which support them, and are in a better situation to obey the signals which may be made to them. Besides, there will always be some frigates of war on the wings, to windward of the van and rear of the convoy, to look out, and keep these vessels in their stations.

When the fleet shall be ranged in order of battle in presence of the enemy, all the ships unfit for action, are to be placed out of the range of the guns, on the other side of the enemy, and as far distant from the repeating-frigates as these repeaters are from the fleet.

The fire-ships and frigates are to be to windward, if the fleet in the action has the weather gage of the enemy; but, if the fleet has the lee gage, they are to keep a-head of the Admiral of their respective divisions, no farther than to be able, by tacking, to fetch them easily.

In the order of retreat, the fleet being formed on the starboard and larboard lines of bearing, and including between them the obtuse angle of 135 degrees, the vessels of the convoy are to keep a league a-head of the fleet, in order not to obstruct them in their manœuvres.

In the order of convoy in three columns, the Admiral of each division is to have his repeating-frigates a little a-head of his division

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to windward; and, to leeward, in the intervals of the columns. During the action, they are to be on the beams of their respective Admirals, out of gun-shot of the enemy, and on the other side of him, to repeat the signals with promptitude and exactness.

ARTICLE I.

Of the order of convoy.

The order of convoy is that which a fleet holds in making a straight course; the ships being all in the wake one of another, steering on the same point of the compass, and forming a right line. If the fleet be numerous, they may be divided into three columns, which are to be ranged parallel to each other, that of the Admiral occupying the middle, and steering all three the same course.

The order of convoy should be formed so as to keep the ships as much as possible close to one another; that they may protect without obstructing each other in the course of their navigation, which ought to be the most rapid possible.

ARTICLE II.

Of the order of sailing.

The order of sailing is generally held when the enemy is expected to be met with. This order is to be such as may, with the greatest ease and celerity, be changed for that of battle, keeping the fleet at the same time as much collected as possible, in order that the ships may mutually protect and assist each other, without losing any thing of their headway; for, it is necessary that this order of sailing should contribute to accelerate the steering of the whole fleet.

ARTICLE

ARTICLE III.

Of the order of battle.

The order of battle is to be preserved in the presence of the enemy.

It ought to be formed so that the ships may reciprocally protect and support one another; preserving, nevertheless, the necessary distance for manœuvering easily during the engagement, and cannonading the enemy with facility, without exposing each other, or committing mistakes while they are engaged.

ARTICLE IV.

Of the starboard and larboard lines of bearing.

There are two lines when close hauled, distinguished by the *starboard* and *larboard* lines of bearing. The line by the wind on the starboard tack, called the starboard line of bearing, is when the ships, whether sailing or lying-to, are so situated with respect to each other, that the bowsprit of the one should exactly point to the stern of the headmost throughout the whole line, preserving all the same bearing, and hauling their wind close with the starboard tacks on board.

The line by the wind on the larboard tack, or the larboard line of bearing, is the same with respect to the ships respective situation to each other, except they haul their wind close with their opposite tacks on board.

The order of sailing of a fleet, on one of the lines of bearing, is that which they hold in going from the wind, preserving the same direction, with respect to each other, as on one of the lines of bearing. A numerous fleet is divided into squadrons; and every squadron is ranged in the order of sailing on the same tack as the division of the Admiral, and standing on the same course with him.

ARTICLE V.

Of the advantages and disadvantages of fleets which come to action with the lee or weather gage.

THE order of battle is that which a fleet maintains when ranged on a line close by the wind, on the starboard or larboard tack, and all the ships lying-to, or standing-on, at a cable's length distance more or less from each other, in order that, during the action, they may have a space sufficient for manœuvering, and to avoid running foul on the ship a-head, should she suddenly have any of her masts or yards shot away, as it is often the case in fighting with the sails filled. We mention a cable's length, or one hundred fathoms between every two ships, because that space is sufficient for manœuvering with facility, and to avoid running foul of the vessel a-head, by passing to windward or to leeward of her, were she unluckily disabled in the midst of the fire and smoak. Besides, with this distance, the ships are always in a situation reciprocally to support each other, as the interval is not great, and the line not excessively prolonged; for, you must take it as a maxim, that there is as much danger in being too much extended as in being too close in the order of battle.

As fleets never ought to engage but in a line, and close to the wind, it results that one of the lines must necessarily be to windward of the other; and that both lines have consequently their peculiar advantages and disadvantages resulting from their reciprocal positions in respect to the wind. This is what we are going to examine here candidly, in exposing fairly whatever is favourable or unfavourable in either of these two positions.

THE fleet which has the weather gage of the other, has the advantage of determining the time and distance of the action; they may board if they think proper, and follow the enemy close whenever he gives way; they may easily traverse the enemy's line, send fire-ships to their disabled vessels, and detachments to cut off the

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van or rear of the fleet to leeward; finally, they are never annoyed by the fire or ſmoak, as the wind carries it to the enemy. So much for the advantages which the fleet to windward draws from that poſition.

Now, the diſadvantages of being to windward, are an inability to quit the fight when once engaged, without being obliged to paſs through the enemy's line, which is extremely dangerous; becauſe, being already very much injured ſince they are obliged to fly, they muſt expect to be ſtill more ſo; and, as they have no longer in their power to form the order of retreat, it follows this manœuvre is abſolutely a deſperate one. If the fleet to windward tack all together in order to get off, the line to leeward may do the ſame, after having raked the weather ſhips in ſtays, and follow them on the other tack, with the advantage of having gained the wind of the center and rear diviſions of the flying line. If it blows freſh, it is ſeldom the caſe that the weather ſhips have their lower deck guns ſufficiently elevated; whence it reſults that the ſhip being a little inclined on her ſide, the guns often run out again at their ports, after being fired, which very much retards the ſervice of the artillery, ſince the guns are obliged to be bowſed in again every time for loading. Another diſadvantage is, that ſuch of the ſhips as are ſo diſabled as to be obliged to quit the line, cannot eaſily do it, becauſe in veering, for want of being able to tack, they fall between the two lines, where they are raked a-head, and by that means compleatly put in diſorder. But, ſhould they be fortunate enough to be able to finiſh their evolution, it is ſtill very difficult for them, diſabled as they are, to get to windward of their line; and very often they fall foul of the next ſhips a-ſtern to them, which have it hardly in their power to prevent that accident, on account of the fire and ſmoak, eſpecially if the line is much contracted: and, ſhould theſe perceive it, and try to avoid being run foul of by falling back on their next ſhip a-ſtern, and ſo on thus ſucceſſively; it might reſult that from one to the other a great part of the fleet being obliged to

manœuver, their fire would leſſen, and very often ceaſe, by their covering each other; when the diſorder increaſes, and all is loſt if the enemy take advantage of this critical moment.

But theſe inconveniences may be partly prevented, by having the diſabled ſhips quickly towed out of the line by the boats of the fleet, which, for that very purpoſe, ſhould always be hoiſted out from each ſhip before the engagement begins. Otherwiſe, if the ſhips in the weather line, not being too cloſe, have the neceſſary ſpace to obſerve what paſſes a-head of them, and to manœuver, they ought to range themſelves to leeward of the diſabled veſſel, in order to cover her, and approach nearer to the enemy; all the other ſhips bearing up alſo together to preſerve the line.

The fleet on the lee gage have the advantage of ſerving with facility and effect their lower tiers of cannon, in all weathers proper for fleets to come to action: they can quit the engagement at pleaſure: their diſabled ſhips are at liberty to leave their ſtations without difficulty, if neceſſity requires it; thus they find themſelves under cover by the reſt, where they may ſoon be aſſiſted by the frigates. In this poſition, they can form the order of retreat with more promptitude, or continue the action as long as convenient. In ſhort, the lee line of battle can alſo, if ſuperior in number, double the enemy, by making ſome of the ſhips in the van or rear to tack, and put one of the extremities of the enemy's line between two fires.*

Its diſadvantages are, being very much annoyed by the ſmoak, and a continued ſhower of fire from the wads falling on board, repelled by the wind; which, if not attended to, may be productive of very great accidents. The ſhips of the line to leeward cannot attempt to board thoſe of the other, whatever may be their inclination for it: they can hardly do more than accepting the battle, without

* And, if they are formed in time, they have the advantage of cannonading the enemy while bearing down to the attack.

without being able to determine either time or distance. It is but with a great deal of difficulty they can avoid being boarded, or prevent their line being broken, if the weather ships are bent upon doing it; and their fire-ships very seldom are of use.

It results from all that has been said, that the disadvantages of the weather line are less numerous than those of the lee; but, likewise, that they are more dangerous; and the advantages of that line are, in general and in particular, more essential, especially when stronger by a few ships; for, it is only necessary to keep in the line a sufficient number of ships to oppose the same number in the line to leeward of them, and form a detachment of the surplus to attack the ships of the rear of the enemy, and, by bringing them between two fires, oblige them to give way. Then, these ships pushing forward from one to another, and being joined and assisted by such of their comrades to windward as have just got rid of their opponents, will soon be enabled to put the rest in confusion. I, therefore, conceive it is extremely advantageous to have the weather gage, and that, unless compelled by some very unfortunate circumstance, a fleet ought not absolutely to accept the battle while the enemy has the advantage of the wind.

ARTICLE VI.

Of the order of retreat.

The order of retreat is never formed but in presence of the enemy, and when he is absolutely too strong. That order ought therefore to be so formed, that the retreating squadron may have at the same time the greatest possible force to oppose to the pursuing fleet; in order to put the ships of war, and the convoy, if there be any, in the most advantageous position against the attacks of a victorious foe, and, at the same time, to fly with celerity and without breaking, in opposing every where a sufficient resistance to prevent the fine sailing chasers of the enemy from penetrating. The retreating fleet must be able also with promptitude, and without confusion,

confusion, to pass from their present order of retreat to that of battle on both tacks.

THE order of retreat is that which holds a fleet flying before the enemy, the ships being ranged on the starboard and larboard lines of bearing, and forming with those two lines an obtuse angle of 135°, the Admiral, or the largest ship, being at the angular point; so that the vessels on the starboard wing of the ship at the angle will be ranged in order by the wind on the larboard line of bearing, while those on the larboard wing will be close hauled on the starboard tack and line of bearing.*

ARTICLE VII.

Of the naval square.

Fig. 21st. (EVOL. PL. II.) *Order of sailing in three columns, the ships being close hauled on the larboard tack, the columns abreast of each other.*

LET the square ABCD be formed and traced on the middle of the quarter deck; and let the line EF be drawn also, which will divide the ship equally in two, precisely in the direction of her keel, with the point E towards the head: then, drawing the diagonals AC and AB, these two lines will shew the direction on which the ship will lie after going about from the starboard or larboard tacks, running on GE; for, the angles DGE and CGE are each 135°, or twelve

* In Fig. 1st (EVOL. PL. I.) ABC shews the angle of retreat and the ships on the two lines of bearing, sailing right before the wind W; the convoy are included between the wings AB and AC, that they may be protected from the pursuing fleet: one view of this plate will, it is apprehended, serve to give a perfect idea of this order.

N. B. Neither this note, nor the plate which refers to it, are to be found in the original of Mr. BOURDE': they are both the product of an English Officer, a great admirer of our French Author, and who, with *five* more Plates hereafter to come, communicated them to the Publisher as an illustration not unnecessary to the understanding of the text; wherefore we have given both the note and the plate access here with pleasure, and numbered the figure of this plate, 1, that it should not interfere with Mr. BOURDE''s original plates, the next of which bears N° 21.

twelve points of the compaſs, equal to the two courſes when cloſe hauled with the ſame wind W: ſo that AC will be the larboard diagonal, becauſe the ſhip will have her larboard tacks on board, after ſtaying and running on the courſe which that line indicated before her going about; and BD will be the ſtarboard diagonal, becauſe the ſhip will have the ſtarboard tacks on board in ſailing on the direction deſigned by that line before the evolution.

For greater conveniency, let the two lines GH and GI be drawn, making with GE an angle of 67°, 30′, equal to ſix points, on which, admitting what is commonly practiſed, the ſhips are always ſuppoſed to lie, when cloſe hauled; for, ſhips always ſhould, for greater velocity, be within 79° only; or, when keeping more to windward, 55°, as has been ſhewn in the firſt part of this work.

When, being cloſe hauled, you wiſh to keep your ſhip in the line of the wind, you ſhall continue her exactly in the tendency of GH or GI; but if you wiſh to have it exactly on the beam, you muſt keep her in the bearing AB or DC.

This figure is extremely convenient for the Officer of the watch; for whenever he wiſhes to know if he is in his poſt, in the order of convoy cloſe hauled, or large, he will be able to ſee from the points F and E if the ſhips of his column anſwer in the direction of his courſe FE, while the line AB or DC will indicate to him thoſe which ought to be on his beam in the other columns.

Fig. 22d. (Evol. Pl. III.) *Order of ſailing in three columns, cloſe hauled by the wind; the columns coinciding in the direction of the wind, in order to beat to windward with greater facility.*

If the fleet is in three columns cloſe hauled to ply to windward, every ſhip will be obliged, for greater celerity in the evolution, in ſucceſſion, to hold herſelf in the direction of the wind, with reſpect to the veſſels which are to coincide with her in the other columns, which are to windward or to leeward; and the lines GH or GI from the point G, will ſerve for the Officer of the watch to ſee if he

is

is in his poſt; and he will be able to diſtinguiſh, at the ſame time, if the ſhips of his column correſpond with his own directions G E and G F.

Fig. 23d. (EVOL. PL. IV.) *Order of ſailing in three columns, on the larboard line of bearing, the ſhips being cloſe hauled on the other tack.*

IF the fleet, being in three columns, keep all together the wind on the other tack, the ſhips being in the principle exactly abreaſt of each other, the diagonals from the point G will ſerve the Officer of the watch to ſee if he is in his poſt: for, the ſhips of his column ought to anſwer one another in the direction of one of the diagonals A C or B D, while thoſe of the other columns will be found directly in the bearing B D or A C.

Fig. 24th. (EVOL. PL. V.) *Order of ſailing in three columns, on the ſtarboard line of bearing, the fleet plying to windward, and the ſhips going about ſucceſſively when the columns are right abreaſt one of another.*

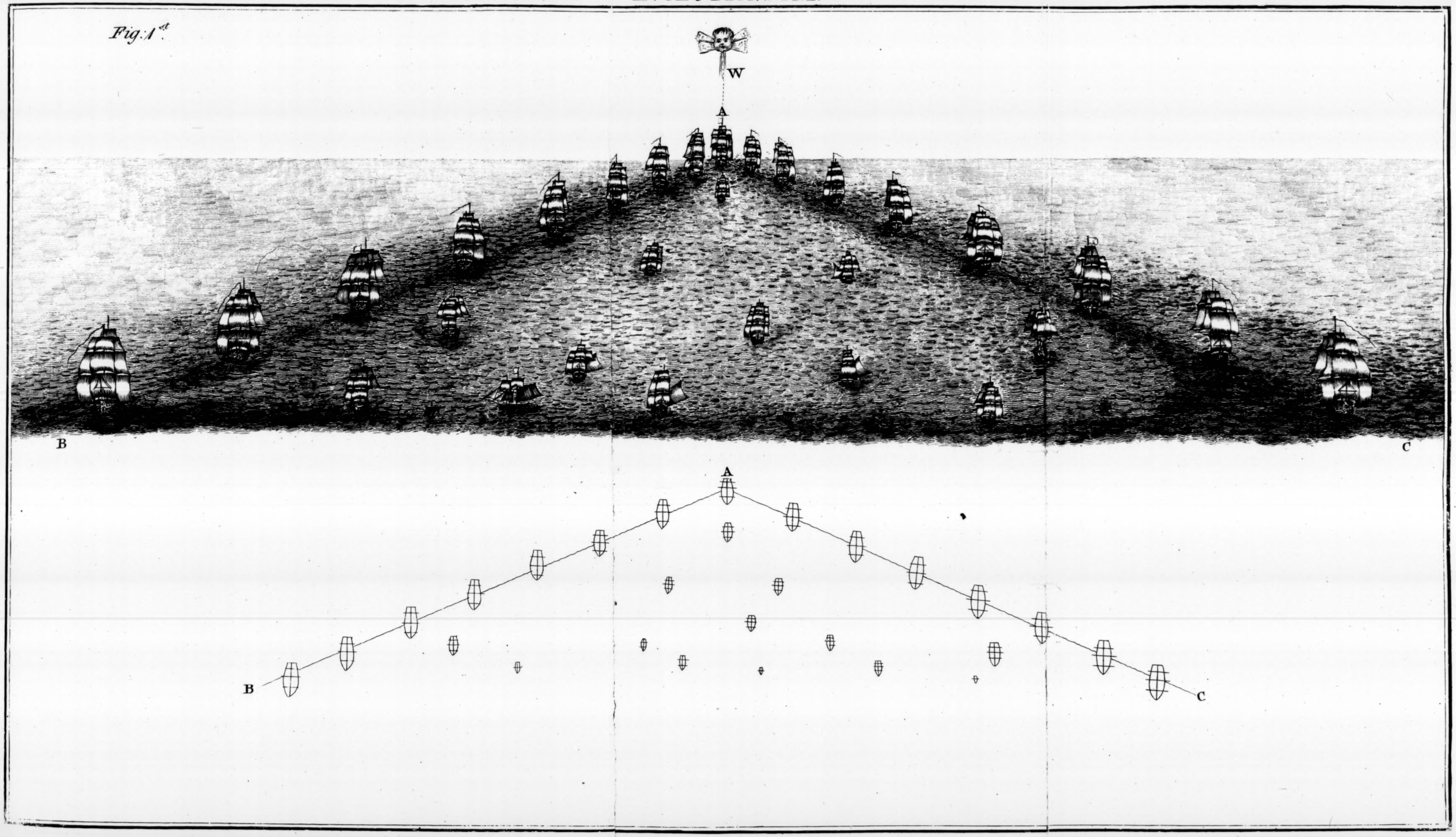
IF the fleet is in three columns, beating to windward, the van ſhips exactly abreaſt of each other (inſtead of being in the direction of the wind, as we recommend it to be done in ſuch a caſe), the van K of the lee column having tacked, the van L of the center column is to ſtand on, till he brings the headmoſt ſhip K of the lee file (which is on the other tack), in the direction of the diagonal B D to leeward of him: then he is to heave in ſtays, while the leading ſhip M, of the weather column, ſtands on till ſhe brings in the direction of B D the headmoſt ſhip L of the center file, which is alſo in the ſame bearing with reſpect to K, the van ſhip of the lee column, ſince they are both on the other tack; and then ſhe is to tack like the other two, and the three ſquadrons will follow, exactly in ſucceſſion, the flag Officer of their reſpective diviſions.

ARTICLE VIII.

Of the counter-march, or manœuvre in ſucceſſion.

THE counter-march, or what in the Britiſh Navy is called manœuvre in ſucceſſion, is when a fleet, ranged in one of the orders of

EVOLUTIONS Pl. I.



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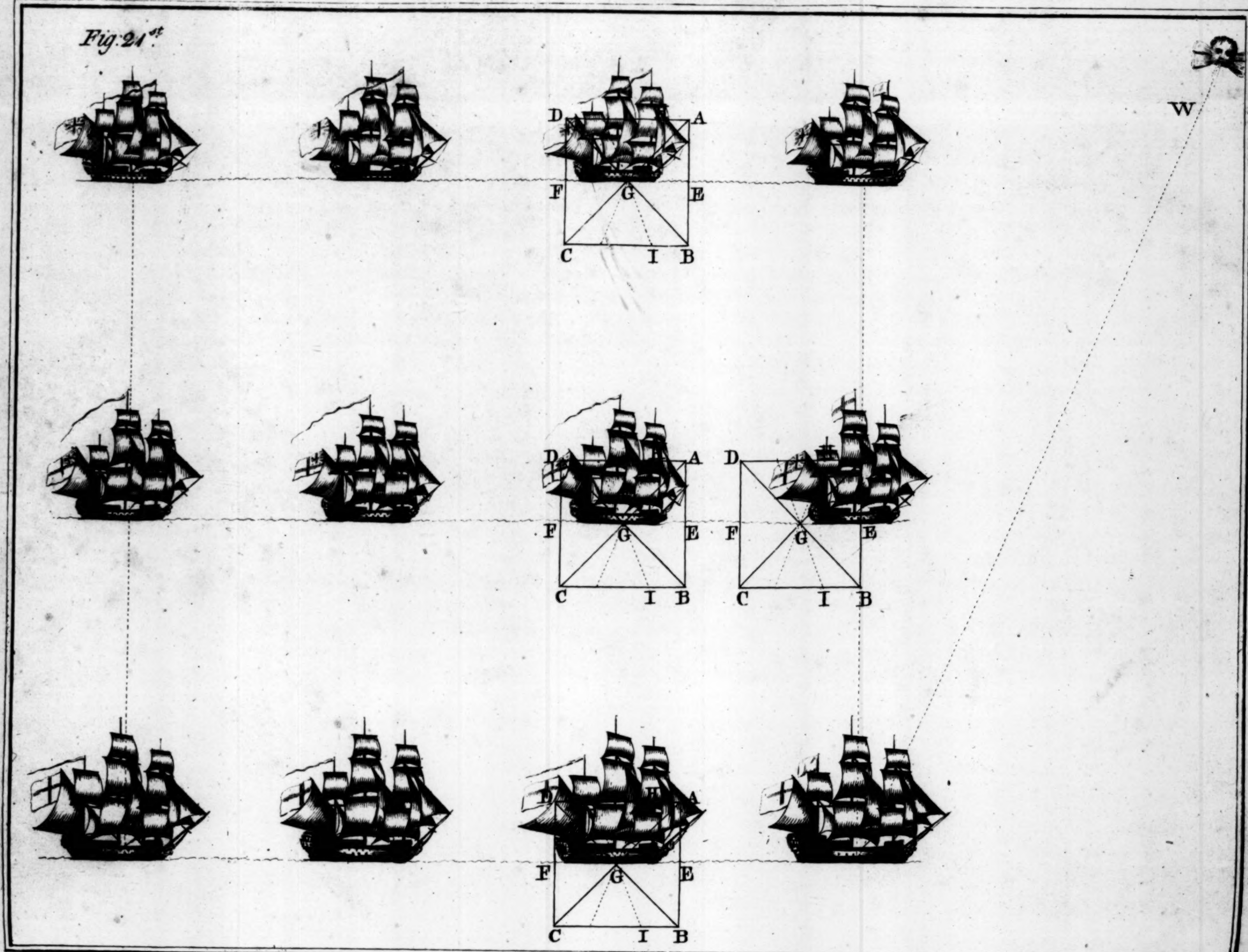
EVOLUTIONS Pl. II.



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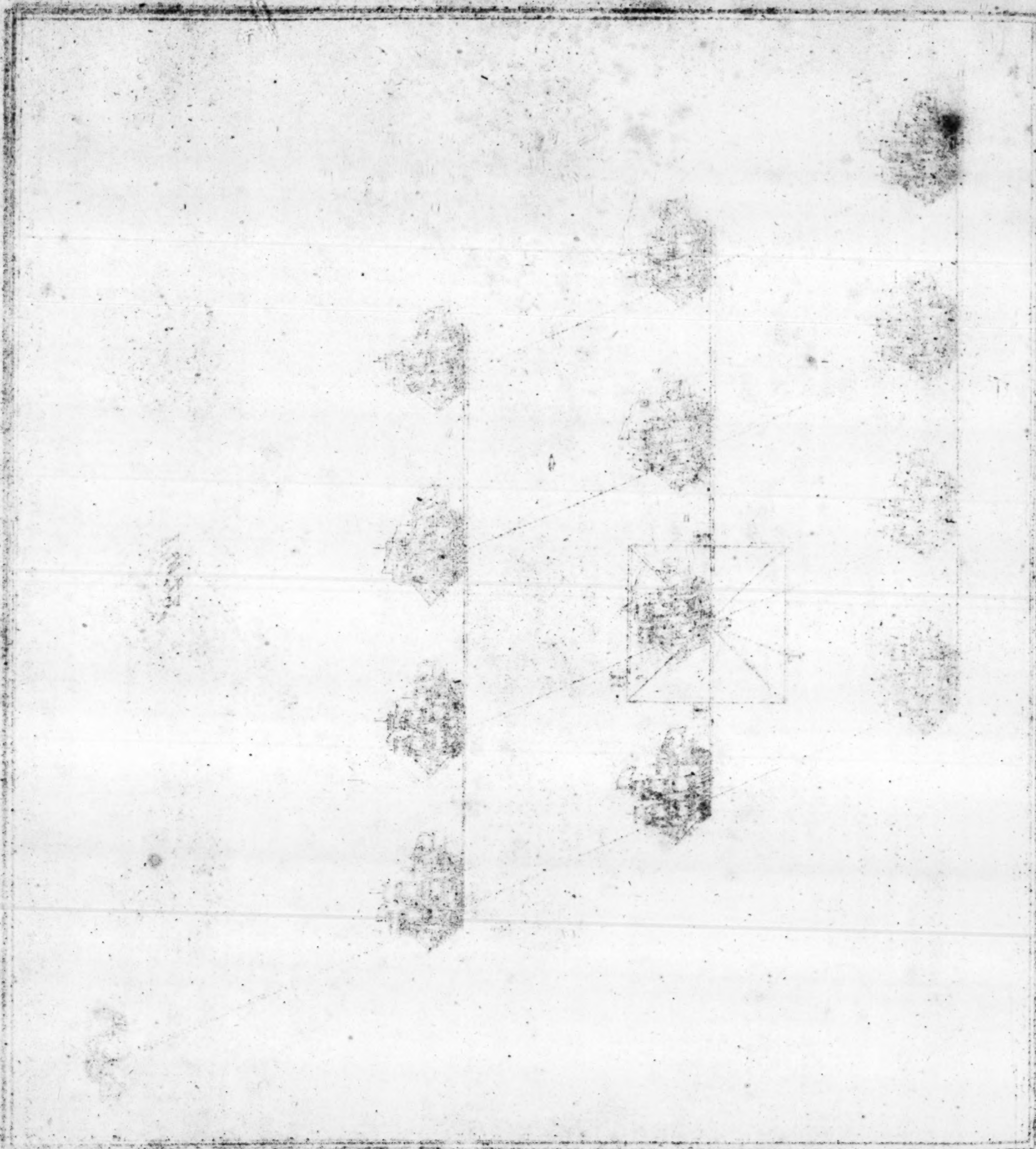
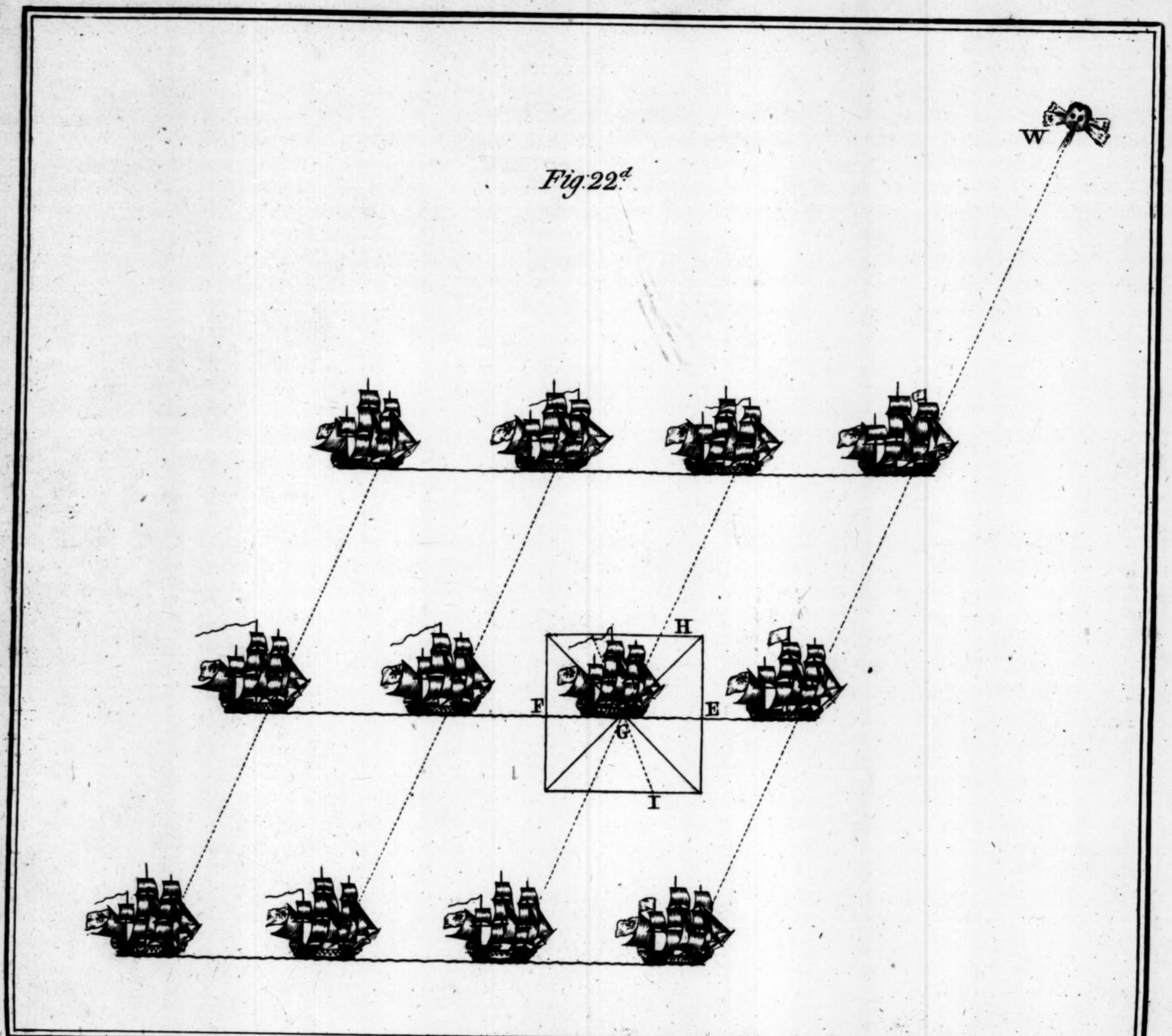


EVOLUTIONS Pl. III.

Fig. 22^d



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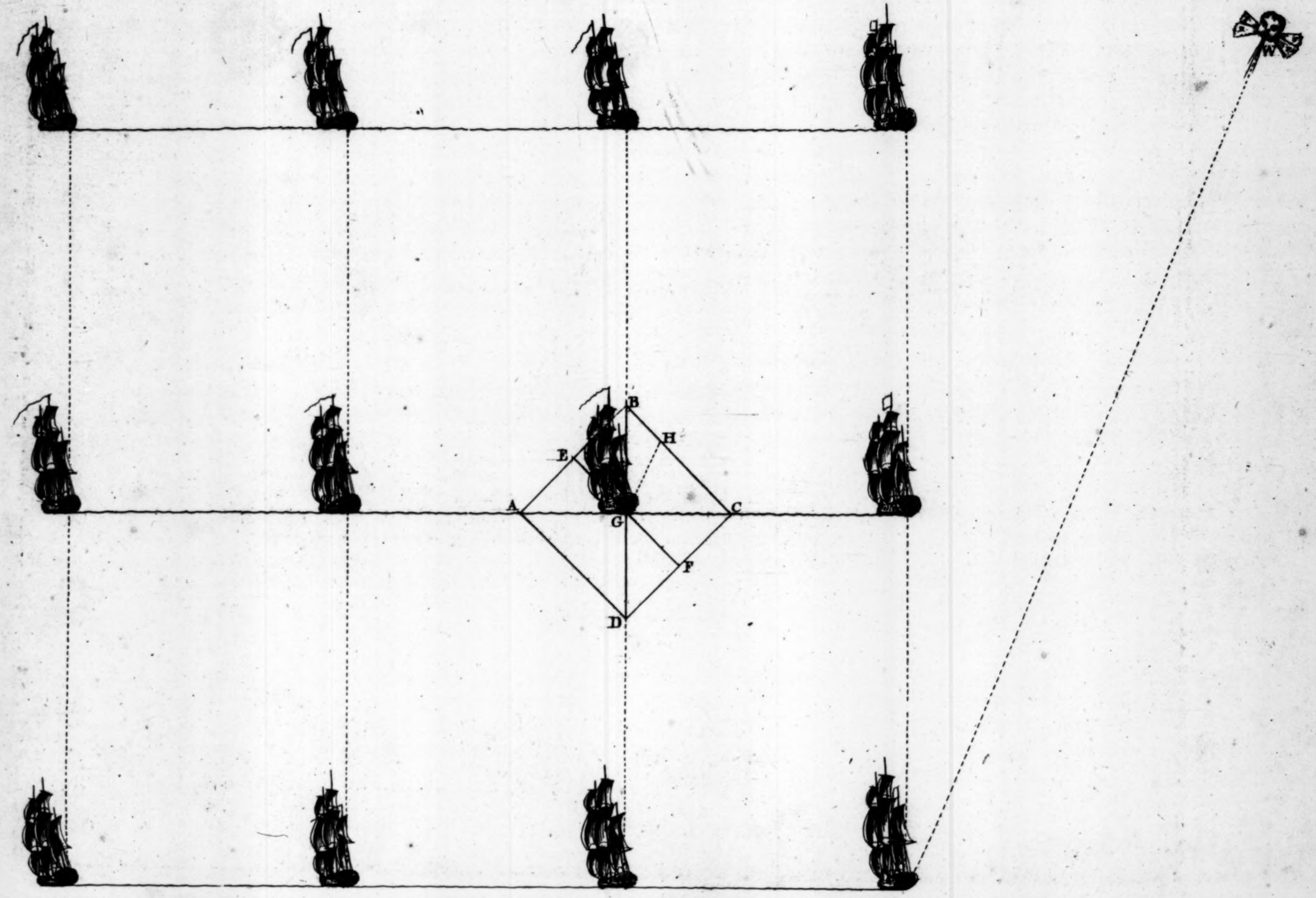
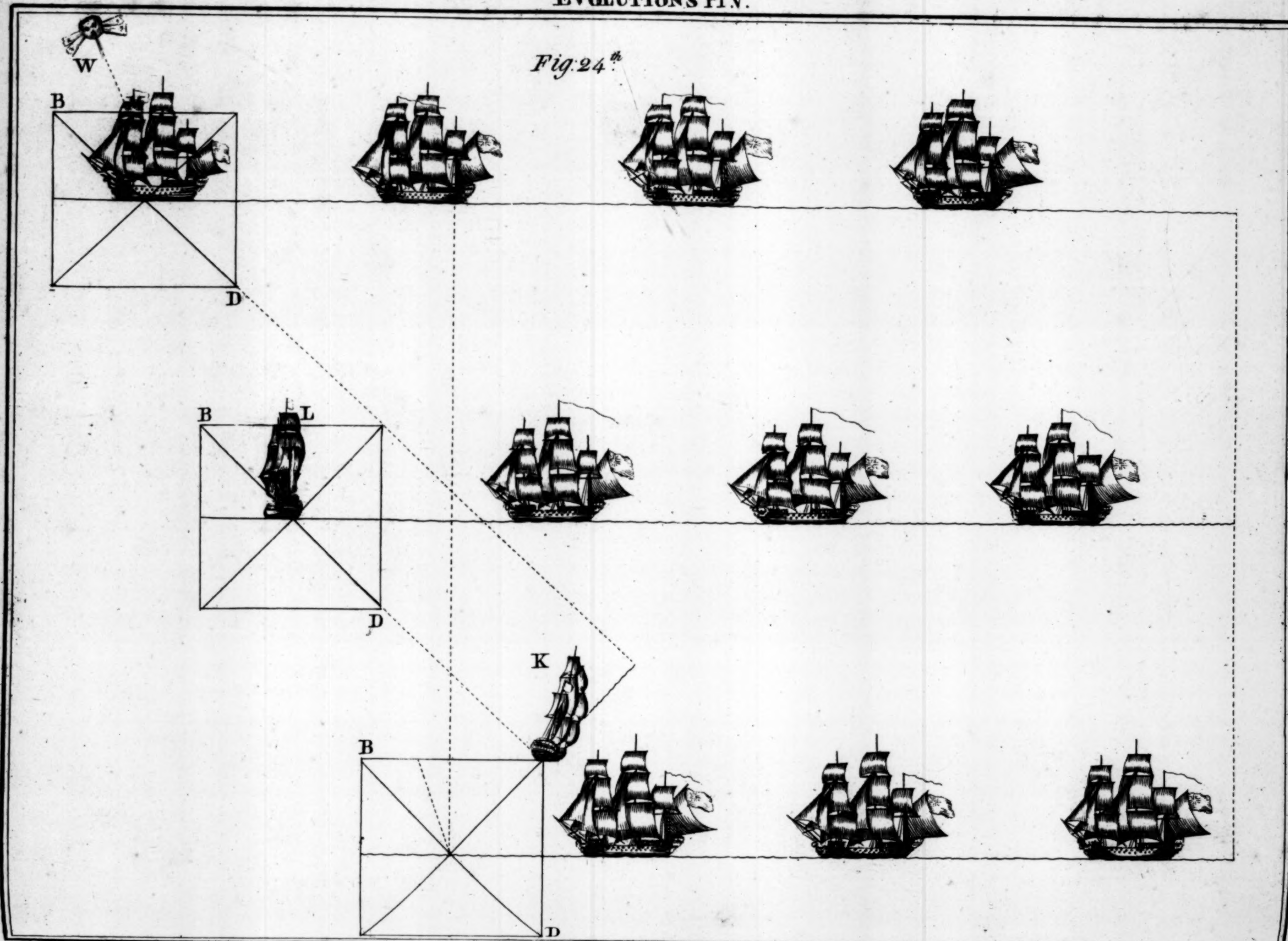
N. C. Goodnight sculp.

EVOLUTIONS Pl.IV.

Fig:23.d



EVOLUTIONS Pl.V.



of ſailing, and ſtanding on in the ſame line, cauſes the ſame manœuvre to be performed ſucceſſively by all the ſhips, as they arrive at the ſame point of the wake of the van ſhip of the whole fleet in one ſingle line, or of the van ſhip of each particular diviſion, when divided into ſquadrons: ſo that a fleet tacks or veers in ſucceſſion, bears away or comes to the wind in ſucceſſion, when all the ſhips of every line execute one after another the ſame movement, on the ſame point of the wake of the leading ſhip of the file.

General obſervations on ſucceſſive evolution.

WHEN the ſhips are at a hundred or two hundred fathoms diſtance from each other, and the next ſhip a-head heaves in ſtays, it will be neceſſary that the ſhip which is to tack immediately after in her wake, ſhould always, and in all caſes, when come to a certain point, overſhoot a little that point, that ſhe may not incommode the ſhip a-head of her, and which is head to wind in her manœuvre; for, very often, it happens that the hundred or two hundred fathoms are ſooner run over, than the veſſel a-head has been able to fill her ſails on the other tack.

REMARKS.

IF a ſhip miſſes ſtays, when a fleet or a column is about getting on the other tack in ſucceſſion, ſhe is immediately to file again on the ſame tack and make ſail with all poſſible diſpatch, taking care to keep as cloſe as ſhe can to the wind, and not to fall off to leeward too much. By theſe means ſhe will get a-head, and to windward of the ſhips which follow and are a little to leeward of her; or they will go and perform ſucceſſively their evolutions in the wake of the ſhips which are already on the other tack, in ſtanding on a little farther than they would have done, if the ſhip a-head had not miſſed ſtays.

By these means the movements of the fleet will not be disturbed; which is of very great consequence; because, the ship which has failed in her evolution, will therefore pay more attention to her manœuvre, in order to avoid running foul of her companions. She will find herself to windward of those which follow her, and be consequently able to return sooner to her station, by making all possible sail to windward of her line.

Such a circumstance as this is sufficient to make Officers sensible how important it is for them to pay a proper attention first to their manœuvre, that their evolution may not fail, and then to that of their ship a-head, that they may be able to act according to her movements in all possible cases, in order to avoid those accidents which may happen from a want of attention in those who have the management of ships in a squadron.

CHAPTER II.

Of the manner of forming orders in general.

ARTICLE I.

How to form the order of convoy on a line.

To form the order of convoy, when the fleet is in no particular order of sailing, the leading ship is to veer sufficiently for the others to get in her wake and steer the same course she holds. Generally, it is the commanding Officer who takes this post, when the squadron is not numerous.

That the order may be the sooner formed, every ship of the fleet or squadron shall chase at the same time that which is to be a-head of her in the line, taking care to manœuver in such a manner as to avoid running foul of those which cross her fore-foot in endeavouring to join their leaders in the file. Therefore, such as are

to

to leeward of others ſhall take care not to perſiſt obſtinately in weathering them; but, they muſt back, or go a-ſtern if neceſſary, by keeping away a little more. Such as ſhall already be in the column, and are to be more a-ſtern, muſt bring-to till they are in their poſts, or ſtand on under a very eaſy ſail, that each ſhip in particular may contribute to the celerity of forming the order.

ARTICLE II.

To form the order of convoy in three columns.

To form this order with celerity, the leaders of each of the three diviſions are to poſt themſelves in a line right abreaſt one of another: and, in order to render the formation of the order more eaſy, they muſt take care to keep a proper diſtance between themſelves, according to the length of the columns, which will accelerate the progreſs of the diſpoſition. Then every ſhip of each particular ſquadron, chaſing that which is next a-head of her in the file, will come and take their ſtations a-ſtern of another at the rear of the leading ſhip of the diviſion, and ſteer directly after her.

This order, which in the practice is very eaſily held, has the advantage of keeping the fleet cloſe and connected, without cauſing any delay in its progreſs towards the intended deſtination; becauſe the beſt ſailers can regulate their velocity by that of thoſe which are inferior to them in ſailing, and, *per contra*, theſe on the other hand may, with a little attention, carry as much ſail as the weather will admit, by which means all imaginable courſes may, without breaking, be ſteered.

ARTICLE III.

To form the order of ſailing in one column.

To form this order, the ſhip which is to be farthermoſt of all to leeward is to bear away, if too much to windward, and ſteer the

course which is directed to her; then all the other ships, chasing each in particular that which is to be a-head of her in the line of battle, will come and take their posts to windward, on either of the two close hauled lines of bearing on which the order is to be formed; so that all the ships being now in their proper stations, they will find themselves ranged what is called *chequer-wise*,* and the whole fleet will be in compleat order.

Another Method.

THE leading ship, being to windward of all, is to keep her luff under an easy sail, while all the rest make all possible sail and turn up to come and take their posts in her wake: when each of them has thus attained her station, the fleet may steer what course may be thought proper, and, by these means, they still get to windward in forming.

ARTICLE IV.

To form the order of sailing in three columns.

IF the fleet be considerable, or if the Admiral wishes it to form the order of sailing in three columns, the three leading ships of the divisions are to take their posts a-breast of each other, in keeping their wind under an easy sail, that is to say, perpendicularly to their columns, when they shall be formed. Then, the ships of each squadron, making sail, will come and range themselves a-stern of them in their proper stations in the file, and keep the same course as they; preserving, with respect to the direction of the ships one from another, the same line of bearing on which the order shall be formed, whatever may be the course the fleet is to steer.

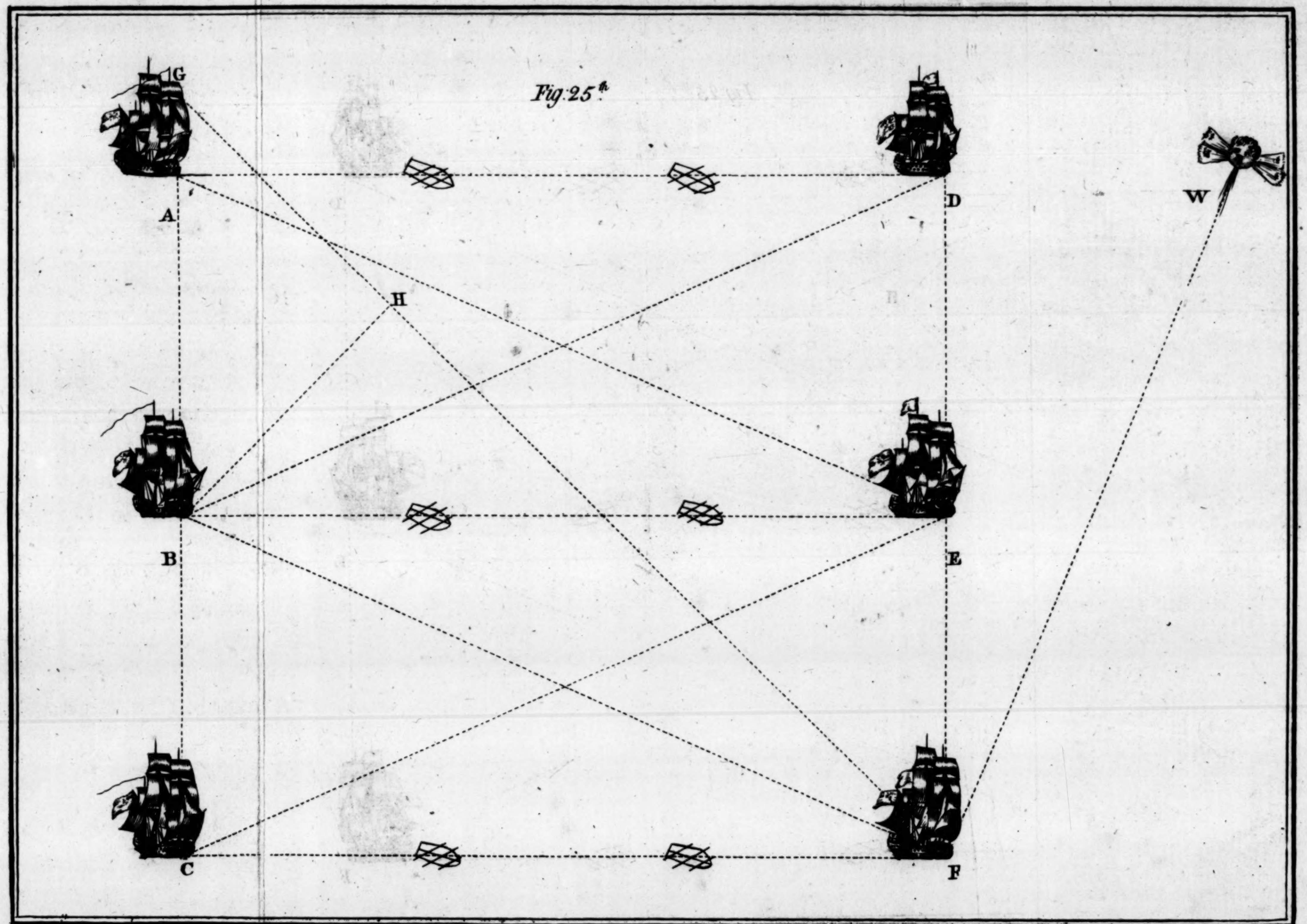
OBSERVATIONS.

As this manner is not the most favourable for plying to windward, it will be necessary that the two weather-columns should make

* The French call this order *en échiquier*, which, for want of a more proper term in English, we have rendered here *chequer-wise*.

[illegible]

EVOLUTIONS Pl.VI.



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N.C.Goodnight sculp.

make ſail till they are out of the direction of the wind of the file to leeward, which, till this is effected, is to leſſen its rate of ſailing.

ARTICLE V.

A principle for finding the diſtance of the columns as ſoon as their length is known.

Fig. 25th. (Evol. Pl. VI.) *Order of ſailing in three columns on the larboard tack; the ſhips ſtanding on large all together.*

To determine, in either of the orders of ſailing, the diſtance of the columns, and the poſt of each ſhip, the number of veſſels which compoſe it, and the length of each column, muſt be known. Then raiſe C G perpendicular to C F, making them equal to each other, in order to draw F G, that you may make F H = C F; and thus you will have G H as the diſtance of the columns from A to B, and from B to C: ſo that the lines A E and B F, in the order of ſailing, being drawn from the rear of the weather column to the van of the leeward column A D, will be perpendicular to the direction of the wind W.

DEMONSTRATION.

Since the van F and the rear B are equally to windward, B F is perpendicular to the courſe of the wind W, of which the angle B F C, equal to the angle B C F, is 22°, 30′; therefore E C F is alſo the half of the angle C F G of the right angled iſoſceles-triangle C G F: therefore the triangles B H F and B C F are ſimilar and equal, and therefore the line B C is equal to B H or H G; q. e. d.

COROLLARY.

It follows that, to have the diſtance of the columns of which the length is known, the ſquare of the length of one column muſt be taken, and then double it, in order to have the ſquare of the hypothenuſe F G of the right angled iſoſceles-triangle G C F: then,

from

from that ſum take the ſquare root by decimals, in order to come as near it as poſſible: then, taking from that root the length of one column, what remains ſhall be the diſtance between the columns.

For example; in fig. 25th there are four ſhips in a column at one hundred fathoms diſtance from each other, and forty-ſix fathoms are allowed for the length of each ſhip from the jib boom end to the fly of the enſign; ſo that every column will be 484 fathoms long, the ſquare of which will be 234256, and the double 468512; which will give the neareſt root, 684 fathoms, from which taking 484, there will remain 200 fathoms for the diſtance requiſite between the columns. This rule will ſerve as a formula for all the files, however long they may be.

ARTICLE VI.

To form the order of battle.

To form the order of battle, the ſhip which is to lead muſt bear away till ſhe is to leeward of the reſt of the fleet, when ſhe will haul cloſe by the wind under her three top-ſails; while all the other ſhips, chaſing each before them thoſe which are to be a-head of them in the line, ſhall come with all poſſible expedition to take their ſtation a-ſtern one of another, and keep their luff directly in the wake of their ſeconds a-head.

Every ſhip ſhall take care to keep exactly at a cable's length, that is to ſay, one hundred fathoms diſtance from the ſhip a-head of her: and to preſerve that regularity in the diſtance, the beſt ſailers muſt have the attention to moderate their head-way, and make it conformable to that of ſuch as do not ſail ſo well, which on their ſide are not to neglect what can poſſibly accelerate their progreſs, that the diſpoſition may be uniform, and the diſtance between each ſhip ſtrictly equal throughout the whole extent of the line of battle.

ARTICLE

ARTICLE VII.

To form the order of retreat.

THE Commander in Chief, or the heavieſt ſhip, which ſhall be deſtined to make the angular point, is to bring-to a little to leeward of the other ſhips of the fleet, which by keeping away will come next and place themſelves in their poſts, at equal diſtances on the wings; ſo that thoſe to the left of the ſhip at the angle, are to range themſelves cloſe to the wind on the ſtarboard tack, with reſpect to one another, and thoſe on the right of the ſame ſhip are to put themſelves in order on the larboard tack: when the two leeward-moſt ſhips, and the moſt diſtant from the ſhip at the angular point, ſhall be at their poſts on the different tacks forming the van of each wing, the order is finiſhed, and the fleet may ſteer the ſame courſe with the Admiral. The heavy going ſhips ought always to make every effort to encreaſe their rapidity of ſailing, and ſuch as have of themſelves a ſuperior progreſſive movement are to regulate their ſail by the velocity of the reſt, taking the greateſt care not to ſwerve from the order.

A general Obſervation.

IN all caſes and in all circumſtances, the ſhip a-ſtern is to keep an eye on the veſſel a-head, in order not to conſtrict her manœuvres, and to avoid running foul of her; therefore, it is the buſineſs of the Officer of the watch always to manœuver conformably to the movements of the ſhip a-head of his, without attending to her which is a-ſtern, whoſe buſineſs it is to have likewiſe the ſame attention to the veſſel a-head of her.

THIS mode of keeping a look out, and of maintaining the ſtation one is in, facilitates the movements and prevents accidents; becauſe, as every one obſerves the ſhip a-head of him attentively, it follows that

that all the vessels execute their evolution in conformity to that which is a-head of them, and thus no mistake can happen. On the other hand, general evolutions never take place till after all the fleet, or division, which is to make the movement, is informed of it by a signal, which is always repeated by the frigates and the flags of the divisions.

CHAPTER III.

Manner of changing orders.

ARTICLE I.

To change from the order of convoy, in one line, to the order of battle, continuing on the same tack.

THE headmost ship is to haul close by the wind on the same tack, and the rest of the fleet are to make the same movement successively, observing not to be more or less distant from one another than the length of a cable, in order that during the firing in the engagement the ships may have the necessary space to manœuver, and avoid the accidents which the loss of masts or yards may occasion. Whenever this method shall be observed, the line of battle cannot miss being soon formed.

ARTICLE II.

To change from the order of convoy, in a line, to that of battle on the other tack.

THE headmost ship is to veer and to come to the wind on the other tack: then, all the vessels of the fleet are to perform the same manœuvre in succession. By this method the order cannot fail being very rapidly changed.

Another

Another Method.

After having formed the order of battle on the ſame tack, as has been ſhewn before, the van ſhip is to tack; and all the ſhips of the fleet are to follow in ſucceſſion, to form the order of battle on the other tack.

OBSERVATION.

If you are ſteering a courſe in the order of convoy, four points large, the order of battle on the other tack may be formed at once, by all the ſhips veering or ſtaying together.

ARTICLE III.

To change from the order of convoy, in three columns, to the order of battle on the ſame tack.

When the fleet ſhall have the wind on the beam, between cloſe hauled and eight points large, the ſhips of the leeward-moſt column are all to bring-to at the ſame time, while thoſe of the other two columns, continuing their courſe, will come and place themſelves on either of the cloſe hauled lines of bearing of the column which is lying-to, in obſerving that the weather column is to make all poſſible ſail; and when come to that point, the headmoſt veſſel of it is to take the lead in hauling cloſe by the wind, with every thing ſet: when that is done, all the ſhips of that column are to follow in ſucceſſion.

When the center ſhip of the weather file ſhall have paſſed the point where the leading ſhip of her diviſion began the evolution, the van of the middle column which is lying-to on the ſtarboard or larboard line of bearing (which ever of them it may be that they are going to ſteer on), and conſequently in the wake of the weather column which is filing off, muſt now file and ſtand on by the wind,

as muſt alſo all the other ſhips which are to follow her ſucceſſively, keeping away large one after another on their firſt courſe, to get into the wake of their leader. The lee column is to follow in the ſame manner, after having filed when the center ſhip of the middle column is cloſe by the wind; and, when the laſt ſhip of that file is in her poſt, the evolution is finiſhed, and the order of battle formed.*

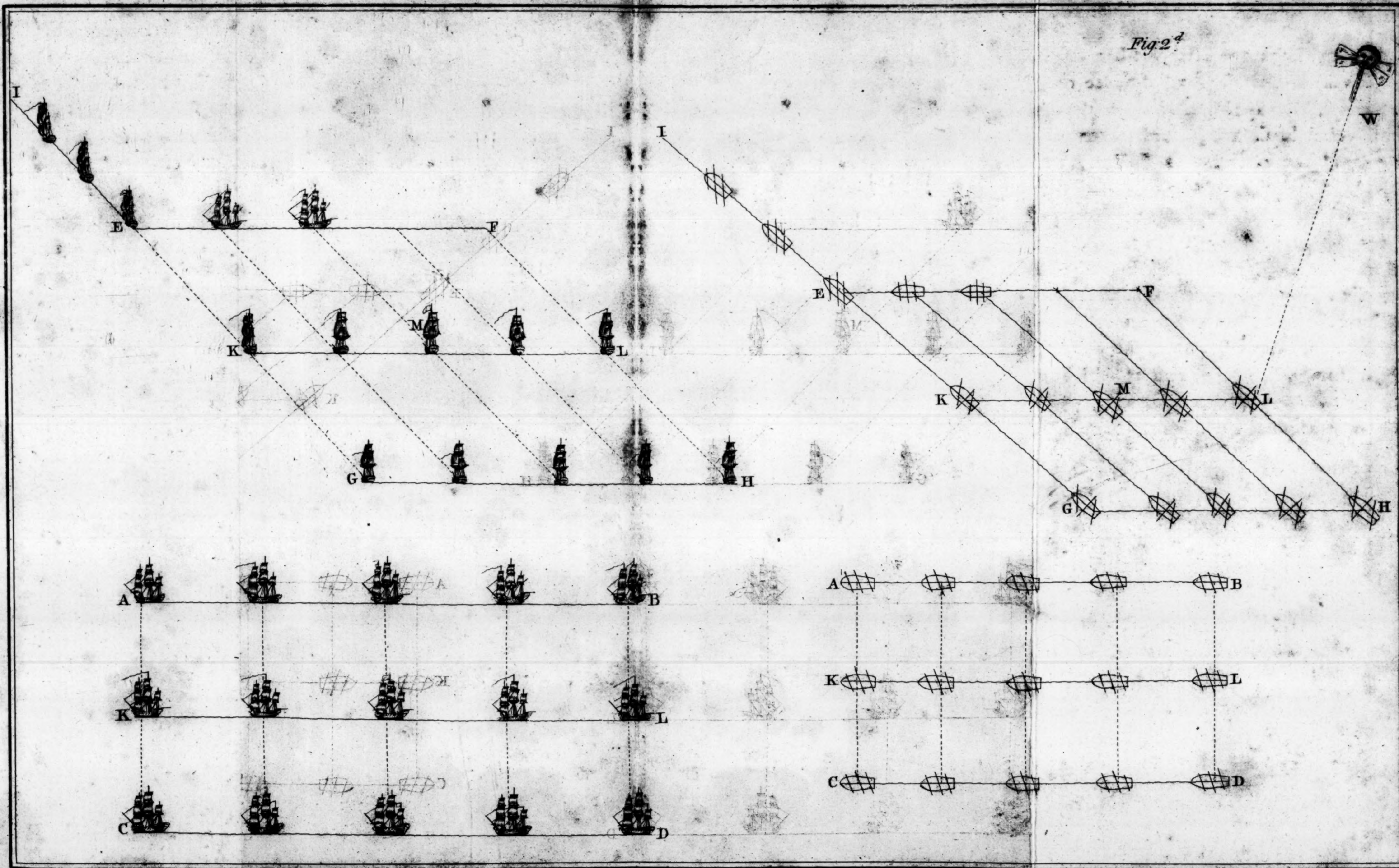
If the wind be more than eight points, or right aft, the column which is to form the van guard in the order of battle, is inſtantly to begin manœuvering, by hauling ſucceſſively the wind with all ſails ſet; while the two others, continuing their courſe, will put themſelves ſucceſſively by the wind, on one of the two lines of bearing which is to be followed, and in the wake of the weather column which is filing off, when, and at which point, they are to make the ſame movement in ſucceſſion, as ſoon as their leaders ſhall have arrived there under a very eaſy ſail, in order to compleat the line of battle.

If

* To illuſtrate this by a figure, let us ſuppoſe A B C D (*Fig.* 2, Evol. Pl. VII.) to repreſent a ſquadron in the order of convoy in three columns, which is their firſt poſition; then E F G H I will ſhew the ſhips in the ſecond poſition, when the middle column has brought-to on the leeward-moſt line of bearing from G to K and from H to L, while the veſſels of the weather file ſtretch on and haul their wind in ſucceſſion at the point E, to form the line of battle from E to I: E ſhews the center ſhip of the weather column having hauled by the wind, K the leading ſhip of the middle file, filing and ſtanding-on cloſe hauled, while the remaining ſhips of her diviſion bear up ſucceſſively on their firſt courſe, from L to K, to haul their wind in ſucceſſion, at the point K, in the wake of their leader: and, when the center ſhip M, of the middle column has hauled her wind, the van ſhip of the lee column at G is to file, and the others are to go through the ſame manœuvre as the middle file, to compleat the order of battle.

If the wind be exactly eight points large, the two lee columns are to bring-to, both at the ſame time, and obſerve they are not to file, nor come ſucceſſively to the wind, till the center ſhip of each column to windward has filed off to follow the leader.

EVOLUTIONS Pl.VII.



N. C. Goodnight sculp.

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If the fleet be close up on a wind, the weather column may lie-to with their main top-sails to the mast, while the two other files, having tacked both together, will come and station themselves in their wake, by running two points large on the other tack, in order by both columns to heave again about afterwards together and file, after having posted themselves in the wake of the column which is lying-to.*

You may get somewhat more to windward, by making the two lee columns keep close by it as soon as they shall be both on the other tack, while the vessels of the weather one shall continue to keep their wind; and as soon as they shall have in their wake those of the other two columns, they will all at once heave in stays and follow the van division.

Another method again may be made use of, *viz.* by making the middle column lie-to, while the weather one shall take post in the van by bearing away two points large, and the lee file shall run also two other points large on the other tack, after having heaved about, both at the same time, to take their station in the wake of the column lying-to, which is itself now to tack with all the others together.

In short, when the case is urgent, you may make the lee column bring-to, while the two weather files shall run together two

* That the idea of this movement may be better elucidated, let us suppose ABCDEF (*Fig.* 3, Evol. Pl. VIII.) to represent the order of convoy in three columns; then, the weather column A B having brought-to, the middle and lee columns C D and E F tack all together to fetch the wake of the file to windward, which is executed by the middle column running two points large on the parallels between C K and C D, till they arrive all together at the points K, L, M, G, in the wake of the weather column, where they are all at the same time to heave about and bring-to on the other tack, to wait the arrival of the lee column, which is by this time to have reached the points *n*, *o*, *p*, *i*, in preserving their course towards the extremity of their parallel N, O, P, I, where they are to tack to compleat the order of battle, as is exhibited from A to I.

points large, to take one after the other their poſt a-head of the column lying-to.

ARTICLE IV.

To change from the order of convoy, in three columns, to the order of battle on the other tack.

The ſquadron might be put firſt in order of battle, on the ſame tack; then, making the veſſels ſtay in ſucceſſion, they would be all at once in order of battle on the other tack. But, as this method might be thought too long, the time of evolution may be diminiſhed, by making the two weather columns bring-to when the wind blows between the direction of cloſe hauled and eight points large, while the ſhips of the lee column ſhall veer in ſucceſſion and keep their wind on the other tack. And, when the center ſhip of that column ſhall have filed off, thoſe of the middle column ſhall file all at the ſame time, the leader of that column running exactly with the wind right aft, with the remainder of his ſhips following him in ſucceſſion, till they are in the wake of the column which is filing off. Then, that leader of the middle column is to haul by the wind along with all the ſhips of his diviſion, which are to follow him in ſucceſſion; and when the center ſhip of that column ſhall have alſo filed off, the weather ſquadron is to file in turn, go through the ſame movement, and thereby to compleat the formation of the order of battle.

If you are cloſe up on a wind, the line of battle on the other tack may be formed by the weather column heaving in ſtays in ſucceſſion, and keeping the wind on the other board, while the two other ſquadrons, continuing their courſe, will come and execute the ſame manœuvre in ſucceſſion, each of them at their ſeveral points of the wake of the van diviſion, in order to compleat the order of battle.

ARTICLE

ARTICLE V.

To change from the order of convoy to that of retreat.

If the fleet or ſquadron be in the order of convoy in one line, they are firſt to form in the order of battle on the ſame tack; then the van ſhip is to bear away four points, and all the fleet following cloſe hauled, they will come to file off in ſucceſſion at the ſame point in the van ſhip's wake, till the center ſhip arrives at the angle where the evolution began. Then, the order of retreat will be formed, and any courſe whatever may be ſteered, ſince the two wings will be equal and in order on the ſtarboard and larboard lines of bearing, forming conſequently between them an angle of 135 degrees.

If the fleet be in the order of convoy in three columns, they are to form the order of battle on the ſame tack, as has been ſhewn before; then the van ſhip is to bear up four points, and all the fleet, following by the wind, ſhall perform the ſame manœuvre in filing off in ſucceſſion, as far as the center ſhip of the column, in order to form the order of retreat on the two cloſe hauled lines of bearing.

ARTICLE VI.

To change from the order of battle to that of retreat.

This evolution is the ſame as the preceding; for the head ſhip is to bear away four points, and half the fleet are to perform the ſame manœuvre in ſucceſſion as far as the center ſhip, which is to form the angular point in the order of retreat, which will be then formed in two wings ranged on the two cloſe hauled lines of bearing of the ſtarboard and larboard tacks, according to the definition.

ARTICLE VII.

To change from the order of battle to the order of convoy, in one line, on the same tack.

The van ſhip is to bear away as far as the intended courſe, and the reſt are to execute the ſame manœuvre in ſucceſſion; ſo that, when the rear ſhip ſhall have made the ſame movement, the evolution will be compleated, and the order of convoy formed on the ſame tack.

ARTICLE VIII.

To change from the order of battle to the order of convoy, in one line, on the other tack.

The van ſhip is to tack and run one point large on the other ſide, till ſhe can bear up as far as the courſe which the fleet is to hold, by paſſing not a-head but under the ſtern of the rear ſhip. All the ſhips are to perform the ſame manœuvre at the ſame points, to change the order and get upon the other tack, all of which will be compleated when the laſt veſſel ſhall ſteer her courſe in the wake of the ſquadron.

OBSERVATION.

The van ſhip, inſtead of tacking, may veer and run a little time before the wind, before getting on the other tack: then ſhe will heave to the wind on the fleet's courſe, without fear of breaking through the rear. This movement is ſhorter, and to be preferred, ſince the order of convoy is never held to keep by the wind.

ARTICLE IX.

To change from the order of battle to the order of convoy, in three columns, on the ſame tack.

The three van ſhips, or leaders of the columns, are to bear up together and ſteer on the intended courſe of the fleet; then the ſhips

of

of each ſquadron are to execute the ſame manœuvre in ſucceſſion, in following the ſame direction; ſo that the three rear ſhips, veering at the ſame time in the wake of their reſpective columns, will compleat the evolution.

OBSERVATION.

The columns will find themſelves too diſtant from each other; but as there is nothing which diſturbs them, and they have the wind right aft or very large, it will be eaſy for them to cloſe as much as may be neceſſary.

ARTICLE X.

To change from the line of battle to the order of convoy, in three columns, on the other tack.

The three van or leading ſhips of the diviſions are to heave in ſtays at the ſame time, and bear away on the perpendicular of the wind on the other tack: then the ſhips of each ſquadron are to perform the ſame manœuvre in ſucceſſion; and, when the rear ſhips ſhall have turned about and be in a line with their reſpective columns, and the leaders of the weather diviſions ſhall, by crowding all the ſails, have come a-breaſt of the van ſhip of the lee ſquadron, the evolution will be compleated.

OBSERVATION.

If the fleet is to ſteer more large than the perpendicular to the wind, it will be eaſily formed, by making the leaders and their columns bear away in ſucceſſion, then putting afterwards the files at the neceſſary diſtance from each other.

ARTICLE XI.

To change from the order of retreat to the order of battle.

As, in the order of retreat, they fly commonly with the wind aft, the fleet ſhould in that caſe range to the wind all together ſix points

on

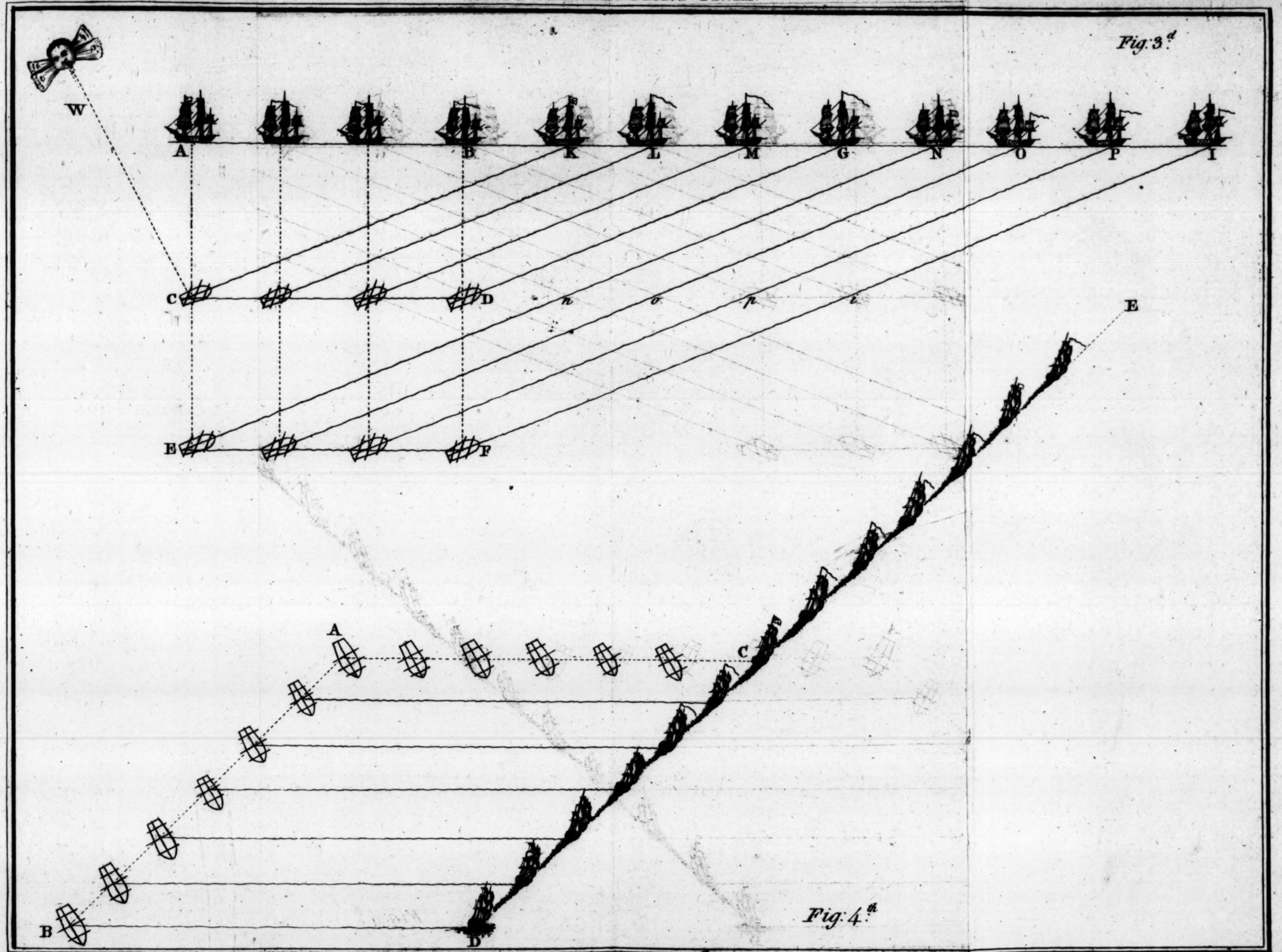
on the tack on which they mean to engage; and, immediately after, the same van ship on the tack of which you have heaved to the wind, shall haul close by the wind on the same side; then all that wing filing off on the same course shall make the same movement in succession, while the other wing, continuing to run four points large, will come without any difficulty to form the line all at once in the wake of the weather wing, which is at that very instant finishing to form in the order of battle, in facing the enemy's ships which are attacking.*

OBSERVATIONS.

If the fleet which flies is attacked by one detachment only, and is not very much urged on, the wing attacked is to heave to the wind six points on the same side as the enemy; and the van ship is at the same time to haul close by the wind on the same tack, while the ships of the other wing shall have come all together to the wind on their line, to veer in succession in the wake of the wing which is attacked, in filing off at the angular point in order that the enemy may be exposed to a heavier cannonade, because, as it is easy to conceive, they will be kept longer between two fires, since the ships form successively in order of battle, in the wake of the van ship.

REMARKS.

* This being a manœuvre at once essential and very ingenious, we shall endeavour still more to elucidate it in Fig. 4, Evol. Pl. VIII, where, BAC representing an horizontal section of the order of retreat before the evolution, the parallels between AC and BD are those on which the ships of the wing AB steer, to arrive at their extremities, at which time they are in the wake of the wing AC, the vessels of which have hauled their wind successively from C to E: then, the wing AB being arrived in the wake of the wing AC (the last ship of which has first filed off at the point C), the ships of that wing are to haul their wind together, and thus compleatly finish the order of battle D.E.



Publish'd 26th Augt 1787 by S. Hooper.

N. C. Goodnight sculp.

REMARKS.

If you are preſſed on both ſides by the enemy, one of the wings muſt run four points large in the order of convoy, all the ſhips in the wake one of another, without any of the veſſels going out of their line of bearing; while the other wing ſhall ſteer cloſe hauled on the ſame tack, and the ſhips of that wing come ſucceſſively into the wake of the other at the ſame point of the angle, where they are to bear away four points in ſucceſſion: and, when the laſt ſhip is come cloſe to the wind, at the point where the evolution began in the wake of the fleet, which is ſteering four points large in the order of convoy, they are to bring, all at the ſame time, their heads to the oppoſite point of the compaſs, by veering or ſtaying, and, by that mean, they find themſelves at once in the order of battle. However, I cannot help thinking this evolution will always be very difficult to execute, when engaged with an enemy who is really ſuperior, or even with one who ſhall only think himſelf ſuch: whereas, that which we have given before has certainly the advantage of being quicker and more practicable, as it is more regular and more ſimple. Beſides, the ſhips which attack are expoſed to the action of two fires as ſoon as they begin to form in order of battle; becauſe, ſuch of the ſhips as are coming to the wind, preſent their ſides, while, at the ſame time, thoſe who are ſailing four points large play upon them alſo the whole of their artillery.

ARTICLE XII.

To change from the order of retreat to the order of convoy, in one line.

One of the wings is to come all at once cloſe by the wind, on the ſame tack as the line of bearing on which they are formed, in order to file off ſucceſſively at the point of the angle in the wake of the

other wing, the ſhips of which are to run together with the wind four points large, on their line of bearing; and when the laſt ſhip of the weather wing is in the wake of her line, the order of convoy is formed.

If neceſſary to ſail more large, the van ſhip and the reſt of the fleet may bear away more, in ſucceſſion: and, ſhould you not wiſh to keep away ſo much, the ſame ſhips may keep their wind more, and follow the van ſhip ſucceſſively.

ARTICLE XIII.

To change from the order of retreat to the order of convoy, in three columns.

You are to form the order of battle in the ſame manner as has been directed before, in bringing the fleet all at the ſame time to haul up ſix points, and the van ſhip cloſe by the wind on the ſame tack, in order to range in her wake in the line of battle, that the three leaders may then come together on the intended courſe, and the ſhips of each diviſion follow ſucceſſively in their wakes. Then, the order of convoy will be formed in three columns on the ſame tack, becauſe, we ſuppoſe you ſhall have had the attention to form the order of battle on the ſame tack as that you have premeditated to give to the fleet when it is in the order of convoy.

CHAPTER IV.

How to reſtore orders in ſhifts of winds.

ARTICLE I.

To reſtore the order of convoy in one line, when the wind comes a-head more than cloſe hauled.

It is eaſy to conceive that the order of convoy cannot be diſturbed by all the ſhifts of wind, as long as it is more abaſt than the

the ſtarboard and larboard lines of bearing; becauſe the ſhips, ſteering large in the wake of each other, can eaſily maintain their poſts, having only their ſails to trim, whether the fleet be in one line or in ſeveral columns. But, if the wind draws more a-head than one of the lines above-mentioned, it is evident, the ſhips being obliged to veer, or pay off, all at the ſame time on the ſame tack, the order will be diſturbed. We ſhall now proceed to give the method to reſtore it on the ſame tack, when the fleet is in one line in the order of convoy. If we ſuppoſe the fleet ſteering large on the ſtarboard tack, and the wind come ſuddenly right a-head, which would immediately throw all the ſails flat aback on their maſts, the van ſhip is to caſt inſtantly to port and bring-to on the ſtarboard tack, while all the reſt of the fleet are to box off, all together and at the ſame time, to ſtarboard, and make all ſail, in order to come with celerity cloſe by the wind on the larboard tack, and get into the wake of the van ſhip, then to tack and take their ſtations ſucceſſively under an eaſy ſail, and bringing-to likewiſe till the rear ſhip, which has a good way to run, be in her poſt.

SHOULD you wiſh to get on the other tack, then the van ſhip is to caſt to ſtarboard, to bring-to on the larboard tack by the wind; then the reſt of the fleet would caſt the other way, to tack afterwards ſucceſſively in the wake of the ſhip which lies-to, and take their ſtation there, as has been ſaid before, with this difference, that, after the reſtoring of the order, you would find yourſelf on the larboard tack.

IF the ſudden ſhift of wind be not quite a-head, or if it be ſix points, or between ſix and twelve, the van ſhip is, nevertheleſs, to bring-to on one tack, while the reſt of the fleet, caſting on the ſtarboard, make all ſail to gain her wake, to tack there, and thus regain their ſtations.

THE order of convoy may be reſtored by a ſtill ſhorter and more ſimple method, but which will cauſe the fleet to drop to leeward

more than the former does. In the ſame caſe as the laſt, when the wind comes right a-head, the whole fleet is to pay off on the ſame tack, if the ſhips are all on one line, and the rear ſhip muſt bring-to, while the reſt of the ſhips, running five points large (if the wind has ſhifted ſix points beyond the direction of cloſe hauled), will come and bring-to ſucceſſively a-head of the rear ſhip on that of the two lines of bearing which they are to hold, obſerving that ſuch ſhips are to carry a greater and proportionable preſs of ſail, as, being nearer the van ſhip, have conſequently more way to run before they can regain their poſts.

OBSERVATION.

It will always be eaſy to know how many points or degrees the weather ſhips have to run large to get into their ſtations, by adding eight points or ninety degrees to the half of the points or degrees the wind has ſhifted beyond one of the two lines of bearing: and, in regaining your poſts, you will have the quantity of points by which you differ from the firſt courſe you ſteered. For example, if you were ſteering eaſt, and the wind ſhift to that point of the compaſs, it will have ſhifted ſix points beyond one of the directions cloſe hauled, which you would have been able to preſerve on the ſame tack; ſo that, adding half of ſix points to eight, you will have eleven points difference from the Eaſt courſe which you ſteered before, and you will conſequently ſail NW$\frac{1}{4}$N on one tack, to reſtore the order or SW$\frac{1}{4}$S on the other, to gain your poſts cloſe by the wind in a line with the rear ſhip, which bearing Weſt before the ſhift of wind, ought now to bear SSW if cloſe to the wind on the ſtarboard tack, or NNW if poſted upon a bow-line on the larboard tack. Therefore, to regain their ſtations in the line, the ſhips run five points large. Had the wind ſhifted four points only, it would have blown ESE; and the ſhips, taking their poſts on the ſtarboard tack, to the NE of the rear ſhip which is lying-to, would have

have steered NNW to fall into their stations, and restore the order of convoy on the same tack.

ARTICLE II.

To restore the order of convoy, on three columns, when disturbed by a sudden shift of wind right a-head.

WHEN the wind shifts on a sudden right a-head, or between the two lines of bearing, the order of convoy is to be restored by the whole fleet casting the same way all together, leaving the three rear ships of the columns lying-to close to the wind on the tack on which you purpose to continue close hauled; while the ships of the three columns running large all together on a course (to leeward of the first), which must always be determined by half the number of points or degrees the wind has shifted beyond the direction of close hauled, added to eight points or ninety degrees, will bear up with ease for their stations in the close hauled line of bearing, which they are to hold to the windward side of their rear ship, where they will arrive successively, in carrying more sail according as they may be nearer to the van, because in that case they have a greater distance to run.

ARTICLE III.

To restore the order of battle on the same tack, when the wind comes four points a-head more or less.

THE rear ship is to bring-to; and all the rest of the fleet are to bear up six points large, if the wind has shifted four points forward, and consequently ten points more to leeward than their first course: then, in proportion as they shall come to the close hauled line of bearing on the same tack as the rear ship which is lying-to, they will

will range again successively to the wind in order to bring-to, till the van ship has taken her post, on the same line of bearing.* But as in this kind of evolution the ships nearer to the van have always more distance to run than those which are nearer the rear, it will be proper for them, as much as possible, to accelerate their motions by a press of sail, that no time may be lost in restoring the order of battle on the same tack.

REMARK.

To know the number of points which the van of the fleet have to bear up in a shift of wind a-head, add eight points, or ninety degrees, to half the points or degrees the wind has shifted; and that sum will give the direction in which you ought to steer, in reckoning from your first course: this principle is the same we have made use of for restoring the order of convoy.

Another Method.

All the fleet are to bring-to, the leading ship excepted, which is to steer ten points to leeward of her first course, to take her post on the line of bearing of the rear ship, with respect to the wind which is then blowing. But, when the van ship, running with all sail set six points large, shall have brought that which follows her immediately on the parallel of the line of bearing on which the fleet are to form in order of battle, that next ship is immediately to veer round six points; and when this vessel is come likewise in the line

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* The frequency of this evolution rendering a perfect knowledge of it indispensable, we shall add a figure which may perhaps assist, in some degree, the conception of such as are not so well versed in naval tactics. In Fig. 5, (Evol. Pl. IX.) let A B be the line taken aback by the wind W, the rear ship of which, after boxing off, has brought-to at B: the rest of the fleet having veered round, steer on the parallels to A C between A and B, to bring-to successively in their post in the line of bearing B C of the rear ship at B, when the order of battle is restored.

line of bearing of the third ſhip, ſhe is alſo to keep away ſix points large: ſo that, all the ſhips of the fleet coming to file off ſucceſſively as ſoon as they are in lines parallel to the line of bearing, on the ſame tack on which the order of battle is to be formed, will run on parallels and preſerve their diſtances one from another, by coming all together, and at the ſame time, at their reſpective points of the line of bearing they are to hold; and the moment all the ſhips are by the wind, the rear veſſel, which is yet lying-to, is to file, and the order of battle is reſtored.*

Another Method.

ALL the fleet are to veer round at the ſame time, and ſteer on the exact oppoſite point of the compaſs from their former courſe; then the rear ſhip which is now become the van, is to veer and haul cloſe by the wind on the ſame tack as ſhe did before; and all the other ſhips will perform the ſame manœuvre in ſucceſſion: by this mean the order of battle will ſoon be reſtored on the ſame tack.

OBSERVATIONS.

* To render this more explicit, ſuppoſe the ſhips in their reſpective poſts between A and B (Fig. 6, EVOL. PL. IX.) to compoſe the fleet taken aback by the wind W; there they are to bring-to from E to A in their reſpective ſtations, while the van ſhip at B bears up and ſteers in the direction B C with all ſails ſet: and, when that ſhip, in ſteering on the parallel B C, has arrived at the point D, ſhe is then on the line of bearing E D of the ſecond ſhip at E, who is now to bear up and ſteer on the parallel to B C from E to F; and this ſhip being come to the point G, the third ſhip at H is alſo to keep away on the parallel H I; and when arrived at the point K in following the direction K I, the fourth ſhip is to bear away on L M parallel to B C; and when ſhe has reached the point N, the fifth ſhip at O is alſo to ſteer in the direction O P; and every ſhip, when in the line of bearing of her ſecond, is to execute the ſame manœuvre in ſucceſſion: and, when the ſhip at Q, in ſteering on Q R, has arrived at the point R (which ſhe will do at the very ſame inſtant the van ſhip B arrives at the point C, as do at that very ſame inſtant the veſſels from their former ſituation at E, H, L, O, at the ſame points F, I, M, P), then the rear ſhip at A is to fill, and the order of battle is perfectly reſtored, ſince all the ſhips come in the ſame inſtant to their poſts in the line from A to C.

OBSERVATIONS.

This evolution, which inverts the van and rear, is no ways inconvenient, and may be performed in very urgent circumstances, such as to get a-breast of an enemy who wishes to avoid an engagement, to double a cape in plying to windward, or to avoid some danger.

If in a shift of wind four points forward, you wish to restore the order of battle on the other tack, all the ships of the fleet are still to veer round till their heads come to the opposite point of the compass; and the rear ship, being now the van, is to haul close by the wind on the same tack: then all the other ships will come and execute the same manœuvre in succession, to form the order of battle on the tack, more to windward than the preceding, which would put them besides in a good situation to pass, in veering in succession, to the same order on the other tack; an evolution very easy to execute when the squadron is not numerous.

ARTICLE IV.

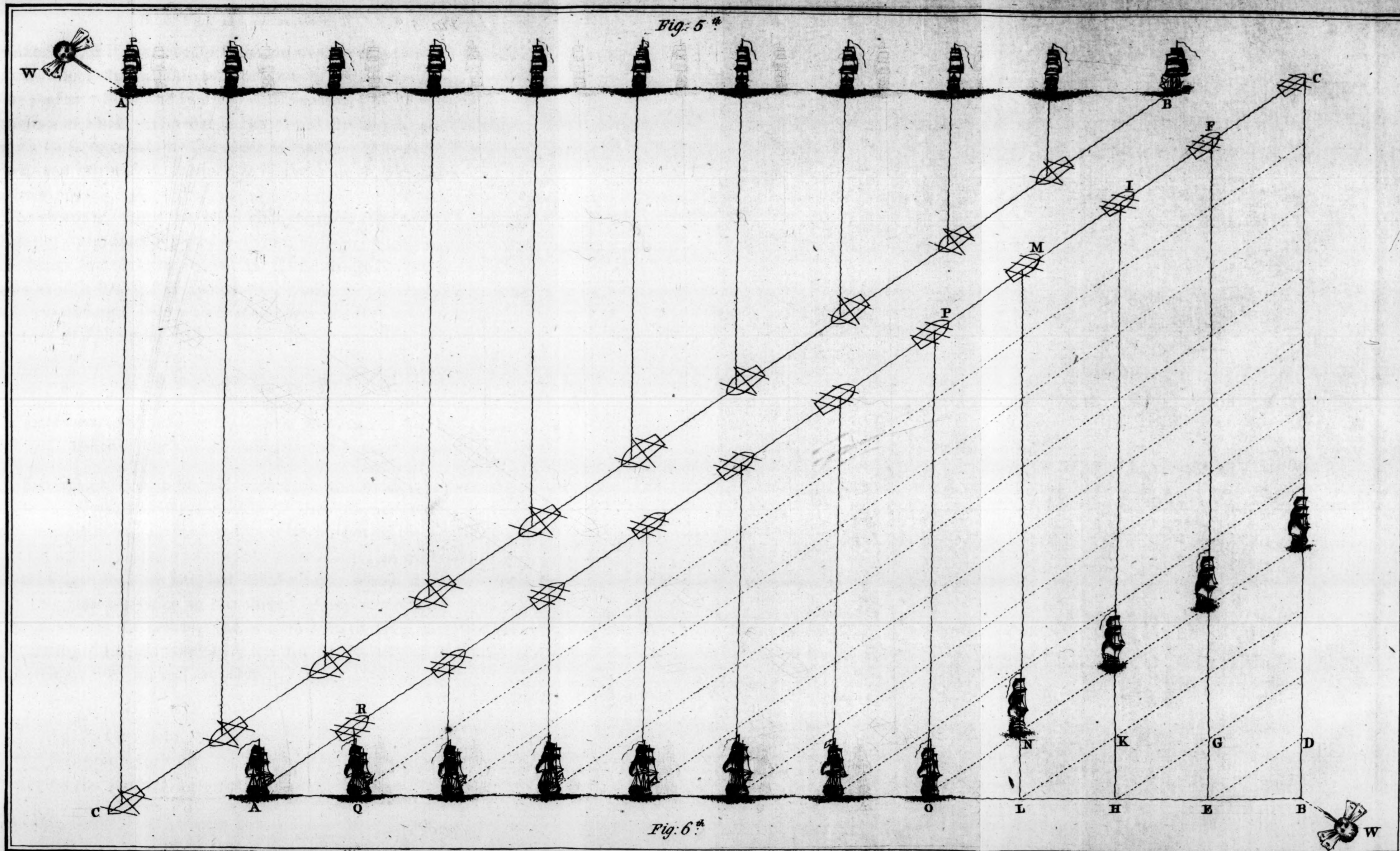
To restore the order of battle when the wind shifts twelve points coming from forward.

The order of battle will not be disturbed by this event, as the fleet has only to brace sharp round the other way, to be in the order of battle with the opposite tacks on board; and it will be again as easy to return to the same order on the same tack as before, by either tacking or veering in succession to haul close by the wind.

REMARKS.

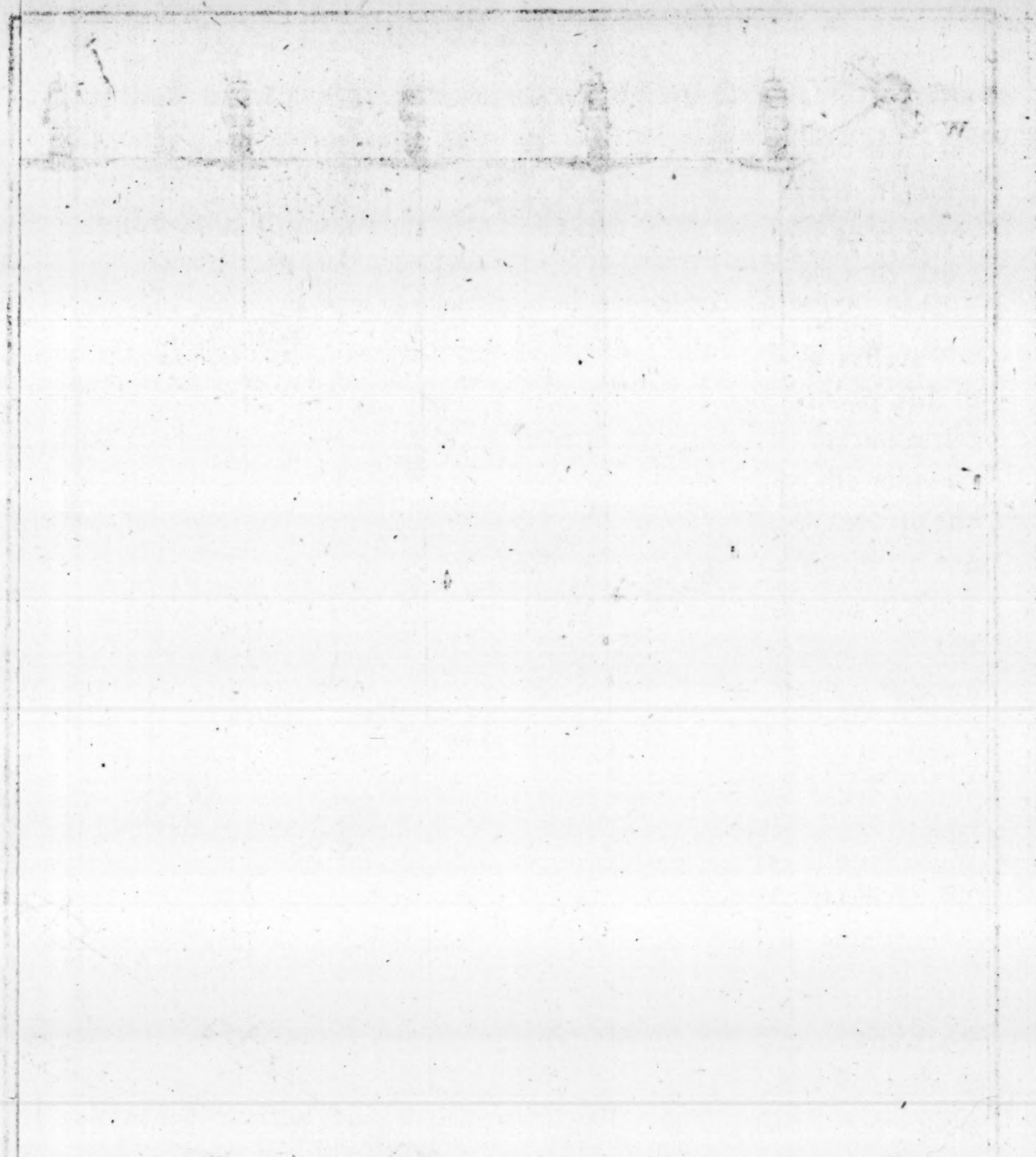
It must be observed that, if you know how to take advantage of circumstances, it will often save you a great many movements. First, the wind will never be able to come a-head more than six points;

EVOLUTIONS Pl.IX.



N.C.Goodright sculp.

Publish'd 25th Augst 1787 by S. Hooper.



points; for, if it does ſeven points, you are then only to get on the other tack: then, the rear ſhip will bring-to as well as the fleet, if neceſſary; after which the van ſhip will manœuver by bearing away ten points and a half, or, what is the ſame, ſteering large four points and a half, to re-aſſume the order of battle as has been ſhewn before, and in the ſame manner as if the wind had come five points a-head.

Secondly, when the wind changes more than twelve points, it does not come from forward but from abaft; for, if the wind were to change fourteen points, you would be obliged to get on the other tack as if it had ſhifted twelve only; and, as you would ſteer then two points large, you would manœuver in that caſe in the ſame manner as if the wind had come aft the ſame number of points.

ARTICLE V.

Another method of reſtoring the order of battle on the ſame tack, when the wind ſhifts on a ſudden four points more a-head.

The whole fleet is to veer round till the heads of all the ſhips come to the point exactly oppoſite to their former courſe; and the rear ſhip, now become the van by her having got on the other tack, is to haul up in the wind and run four points large; an evolution which is to be followed by the reſt of the fleet, whoſe ſhips are all to get thus into her wake in ſucceſſion. And, when the laſt ſhip is thus arrived in the wake of the head-moſt in the line, all the fleet is to veer together, that they may find themſelves all together in order of battle on the ſame tack as before.

OBSERVATIONS.

It appears very plain, by the preceding article, that if the wind comes four points forward, the fleet may be reſtored to the order of battle on the ſame tack by the evolution therein deſcribed. But,

 ſhould

ſhould the wind ſhift eight points forward, the fleet muſt then reſume the order of battle on the other tack: for, all the ſhips after being taken aback will veer round to the point oppoſite to their former courſe, and reſume the ſame tacks on board as when in order of battle with the firſt wind, before the change. Then, the rear ſhip having become the van, and hauling the wind on the ſame tack, all the ſhips of the fleet will perform the ſame manœuvre in ſucceſſion, to ſteer four points large in her wake: and, as ſoon as the laſt ſhip ſhall be in her poſt, the whole fleet muſt tack or veer together, and thus will form the order of battle on the other tack. By this laſt movement the van ſhip will regain her poſt.

ARTICLE VI.

To reſtore the order of battle on the ſame tack, when the wind ſhifts on a ſudden eight points forward.

The fleet being in order of battle, and ſuddenly taken aback by the wind ſhifting eight points forward, the ſhips are to veer round all together till their heads be on the point of the compaſs oppoſite to their former courſe. Then, the rear ſhip having, by this movement, become the head, is to haul cloſe by the wind on the ſame board; all the other ſhips will follow in ſucceſſion and range in the wake of the leading ſhip; then, when the laſt ſhip is in her ſtation, the order is reſtored on the ſame tack.

ARTICLE VII.

To reſtore the order of battle when the wind ſhifts aſt.

The wind ſhifting aſt, the fleet will be in the order of convoy: then, the headmoſt ſhip is to haul her wind on the ſame tack, and all the ſhips of the fleet muſt one after another execute the ſame

manœuvre

manœuvre in succession; thus, when all the ships are close hauled, the order is restored.

OBSERVATIONS.

THIS method is very simple; and, though it may be a little tedious, it is undoubtedly the only one which ought to be put in practice. For, if the van ship, as well as all the ships which follow by the wind, carry a press of sail, it will much shorten the time of evolution; because, the other ships run large as many points as the wind shifted, and thus are not long before they are able to haul one after another close by the wind.

IF the wind were shifting large four points aft, then the fleet should all together go about at the same time; and, the rear becoming the van, the order would at once be restored on the other tack, without any of the ships running large.

ARTICLE VIII.

To restore the order of battle, when the wind shifts sixteen points.

THE fleet being taken aback by a sixteen points shift of wind, they are all to brace about their yards at once, with rapidity, the other way; then the van ship shall brace up sharp, making all possible sail by the wind on the same board her tacks are on: this evolution being followed by all the ships in the fleet which are to perform the same manœuvre in succession, the order of battle will then be compleatly restored and transferred on the other tack.

Another Method.

A FLEET being taken aback by the wind shifting sixteen points, the yards are all to be hauled about with the utmost celerity for the other tack, by which means the fleet will be sailing four points

large: then all the ſhips tacking or veering inſtantly, and all together, they will regain the order of battle on the ſame tack as they were before the ſhift of wind.

Besides the advantage of this evolution over the preceding, in point of celerity in the execution, it brings the fleet more to windward than the other; which, in certain caſes, is of the utmoſt importance, ſince it may procure the means of gaining the wind of the enemy.

ARTICLE IX.

To reſtore the order of retreat, when the wind ſhifts ſixteen points.

The fleet being in order of retreat, and taken aback by the wind ſhifting on a ſudden ſixteen points, all the ſhips in it are to veer, all at once, till their heads come to the point oppoſite the former courſe; to obtain which, the Admiral is to bring-to at the angular point, while the two wings, having veered round, will run before the wind and bring-to likewiſe in ſucceſſion, on the two different lines of bearing of the then blowing wind, and to leeward of the Admiral; obſerving that the van ſhips of the wings are to uſe all poſſible diligence, by carrying a preſs of ſails, to get to their poſts.

Another Method.

The ſhips of the fleet, in this ſhift of wind, are to manœuver all together and at once in caſting to port; and the wing which is to the left of the Admiral is to haul cloſe to the wind with all ſail ſet, in order to bear away ſucceſſively four points large in the wake of the van ſhip, which, in the very firſt inſtant, muſt have bore away that ſame number of points; while the ſhips of the ſtarboard wing of the Admiral run four points large, under an eaſy ſail, on their own line, in order to haul cloſe by the wind in ſucceſſion, in the wake of the firſt line which is filing off; ſo that, when the laſt ſhip of the ſtarboard wing of the prior order ſhall have come to the

the point where the evolution began, and the Admiral is in the center of the two wings where the first ship of the larboard wing began to veer, the order of retreat will be restored, and, by this movement, the starboard wing will become the larboard.

OBSERVATION.

THE order might again be restored on the other tack, by casting all the fleet at once to starboard instead of port.

THIS method, it is true, would be longer in the execution than the preceding one, but no less safe and certain.

ARTICLE X.

To restore the order of retreat, when the wind shifts less than twelve points.

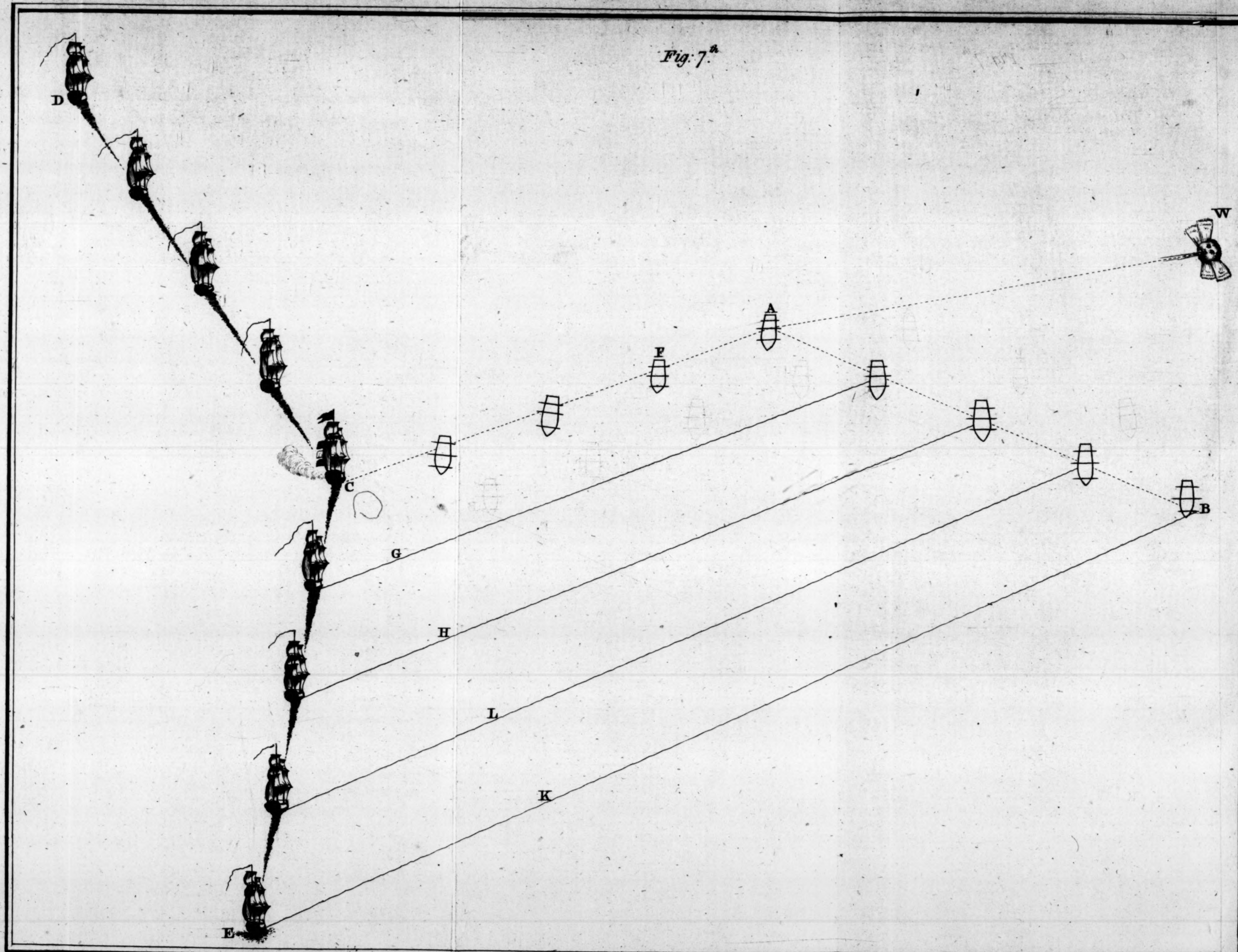
THE wind shifting seven points, the leading ship of the wing which by the shift of wind is become the leeward wing, is to veer and run four points large on the other tack, by bracing the yards the other way; and the rest of the wing having also all veered together, are to take one after another the same course in succession, while the Admiral and the ships of the weather wing, running on the two lines of the prior order, will come and place themselves in each other's wake in succession, at the points where each wing began to file off; and, when at last the Admiral is arrived at the point where the lee wing began to file off, all that wing, as well as the Admiral, must haul close by the wind on the tack they are on; while the vessels of the weather wing, which have placed themselves in succession in the wake of the ship at the angle, continue their course large to come and haul by the wind successively in the wake of the Admiral, whom they ought always to follow in this evolution: so that, when the last ship of that wing is arrived at that point in the wake of the others, the lee wing, having hauled close by the

the wind in the same space of time, and all at once, on the other line of bearing with respect to the reigning wind, the order is restored.*

R E M A R K.

WERE the wind to shift from twelve to fifteen points, the Admiral, in hauling by the wind, would meet the other wing filing off large on the other tack to get into his wake; therefore, to avoid this inconvenience, he must continue to run four points large, on the other tack, with the lee wing, till he sees evidently that,

* This evolution might, in my opinion, be reduced to a greater simplicity by the method we are going to propose. By that method the movements will be fewer, and the distance which the van ship has to run will be diminished more than one third; therefore, it is clear that so much time gained, and so many manœuvres spared in a case of exigency, cannot fail being of the highest importance for a squadron; as it may furnish them an opportunity of extricating themselves by the rapidity of their motion. In Fig. 7 (EVOL. PL. X.), for example, if we suppose A B C to represent an horizontal section of the order of retreat before the evolution, the wind, having shifted seven points, must blow now from W: then, all the ships of the fleet are to bear up seven points from their first course, steering parallel to A C, which is the wing, which by the change of wind is now become the lee one, and the ships of which are now standing in the wake of each other, to veer in succession at the point C, where the van ship, in the first instant of the evolution, veered round and hauled up four points on the other tack from C to D. By the time the ship F of the lee wing shall have veered and got upon the other board, the Admiral, with the wing A B (continuing to run on the parallels to A C between B E and A C), will have arrived at the points C, G, H, L, K; then, the wing from C to D (as also the Admiral), are all to haul by the wind on the same tack; while the ships from G, H, L, K continue to run large on their parallels, in order to haul their wind successively in the wake of the Admiral (who is at the angle), and take their respective stations from C to E; after which the order of retreat D C E will be re-established, and the squadron being formed are to bear away again together. By this method, the van-ship has only to run from B to E on a straight line; whereas, in the former, she went first from B to A, then from A to C, and again from C to E, before she attained her post.



N.C. Goodnight sculp.

Publish'd 25th Augt 1787 by S. Hooper.

that, by hauling by the wind, he cannot disturb the weather wing, the ships of which are getting into his wake.

Another Method.

To render the ideas on the subject still more general and extended, let the wind be supposed to have shifted nine points: in this case, the van ship of the wing to leeward shall run four points large on the same tack, and the other ships of that wing will come in succession to take the same course; and, when the Admiral shall be arrived at the point where the evolution began, the vessels of that wing are to veer round all at the same time, and bring-to in the direction of the line of bearing, as well as the Admiral who forms the point of the angle. As the other wing to windward have at the same time ranged themselves in the wake of the Admiral, in filing off at the angular point of the prior order, they are now to bear up, all at the same time, right before the wind, in order to range themselves on the other line of bearing of the Admiral, on which the ships will successively bring-to. So that, when the leading ship of this line is posted, the order will be restored with this difference, that the wings change position with respect to the Admiral, as that which was before to starboard, will now be to port of the angle; but it cannot be attended with any sort of inconvenience.

THE position of the wings might be preserved, by making the van ship of the lee wing to veer and run four points large on the other tack, then making the rest of the wing file off in succession four points large also, till the Admiral arrives in the wake of that wing, which is then to bring-to, while the weather wing files off four points large in succession on the other tack, till all the ships of that wing are posted on the same line. By this means, the order of retreat will be restored, and the posts of the wings preserved with respect to the Admiral; but the order of the weather wing will be inverted, and the ship which was the van before will now become the Admiral's second.

CHAPTER

CHAPTER V.

How to manœuver a fleet in its various orders without altering them.

ARTICLE I.

Of turning to windward in order of battle.

ALTHOUH a numerous fleet can gain but very little to windward by turning, it is however a manœuvre which often is absolutely necessary, and which never can be better executed than when the ships are ranged in order of sailing on one single line, or in order of battle, which is nearly the same: for, then they will be able to tack and tack again, all together or in succession, according as the circumstance of their situation may require. For example, if a fleet be turning to windward between two shores, with the wind blowing right through the strait against them, their different board can be continued but to a certain point; for the leeward-most ships would soon find themselves close to the shore, were the whole fleet to go about all at the same time; which will necessarily occasion a number of short tacks, if the strait be deep, because else all the weather ships would soon be in, likewise, with the land on the other side. But, if the Admiral, at the end of the second board, takes the resolution to make the fleet go about in succession, he will gain to windward as much as if five evolutions had been gone through all together. By this mean, tacking twice will be avoided; and if obliged to turn any time longer, he will not only get more to windward, but also lose less time.

If the fleet have sea-room, or be turning on a coast with the wind parallel to the land, they will gain much more by all the ships going about in the same instant, and plying by small boards, the one

one in the order of ſailing in one line, on one tack, and the other in the order of battle, on the other; becauſe, each ſingle ſhip going about at the ſame time as the others, the fleet muſt get to windward as much as if a ſingle ſhip only was turning to windward; whereas, if the fleet were to manœuver in ſucceſſion, it would ſhorten their ſtretches in ſhore; and, every time they went about, they would loſe ground, becauſe every veſſel which is going to perform her evolution in the wake of that which went about firſt, is obliged to keep away a little, in order to avoid obſtructing the other in her manœuvre, and to preſerve the neceſſary diſtances. Beſides, the firſt ſhips which tack are always obliged to ſhorten ſail, while thoſe in the rear are obliged to carry all they poſſibly can; and, again, this method requires a conſiderable time when the fleet is numerous: if it is not, then the caſe is of no great conſequence. But, however, there is not the leaſt doubt but the ſquadron will gain more to windward by manœuvering all at the ſame time, and continuing their boards both ways as long as poſſible.

OBSERVATIONS.

It is always eaſy to judge very nearly of the time a fleet will require to go about on the different tacks, as we find from experience that nearly ten minutes are required for a line of battle ſhip to go about and be properly trimmed on the other tack, and even no more than ſix, as I have ſometimes been witneſs of.

It is eaſy to conceive that it is not poſſible to beat to windward with eaſe and advantage, in any other form than the order of ſailing in one line, or the order of battle. We are now going, however, to explain the method of doing it in the order of convoy cloſe by the wind.

ARTICLE II.

To work to windward in the order of convoy, in three columns.

A FLEET being ranged on three columns in the order of convoy, the van and rear of the files corresponding exactly in the direction of the wind,* as well as all the ships which form the columns, and which are all close hauled on the same tack; it will be easy to work to windward, if all the fleet tack at the same time at the end of each board, as the vessels can easily keep their stations in the columns by means of the naval square. In this manner, the fleet in general will gain as much to windward as the worst sailing ships will do, because the best sailing vessels will regulate their progress by that of the others.

ARTICLE III.

To turn to windward in making the columns go about in succession.

THE columns being on the parallels of one of the two lines of bearing, the ships of the one corresponding to those of the other exactly in the direction of the wind, with this disposition it will be easy for the fleet to work to windward, by going about in succession, in making the three van ships to tack at the same time, and the rest to perform successively the same manœuvre at the same point, in the wake of their leaders a-head; so that there will be always three ships at the same time in the act of going about; and the time of the evolution will by this method be considerably shortened.

THE van ships of the lee columns, being exactly in the direction of the wind of the leading vessel of the weather file, will necessarily be

* As in Figure 23.

be a-ſtern, and of courſe have more diſtance to run on the other tack after having gone about, than the rear of the weather column, which will conſequently double them a-head, without being expoſed to be interſected by the van of the lee columns, which will paſs them a-ſtern: whence it follows, that a fleet, however numerous, can turn to windward in the order of three columns, provided the diſtance between the columns be ſuch as have been determined by the principle;* for, if they were too cloſe together, the van of the lee columns, on the other tack, would always interſect the rear of the weather file.†

REMARKS.

THE van and rear of the columns will be in a very natural poſition; for, the leaders, as well as all the ſhips of the three columns, will correſpond with each other exactly in the direction of the wind: beſides, they can ſee at the ſame time, and by another method, if they are in the line of bearing with their ſeconds a-head and a-ſtern, and will conſequently be ſufficiently able to preſerve their poſts. Secondly, the diſtance of columns will be well enough determined for practice; becauſe, if the van of the lee column, after going about and keeping by the wind on the other tack, have the center ſhip of the weather column about half a point to windward of her, the fleet will be tolerably well poſted for working to windward in ſucceſſion. Thirdly, when all the columns ſhall have come on the other tack, the order will never be diſturbed in the leaſt, ſince the ſhips of the one will ſtill correſpond exactly with thoſe of the other in the direction of the wind, and be cloſe hauled, beſides, on the other line of bearing. In ſhort, I do not believe any thing can be

 offered

* See Chap. II, Art. V, p. 239.

† Which have not yet ſtayed.

offered better than this method, which has not always been much approved, though long ago proposed. We shall, notwithstanding, content ourselves with it here, without attempting to propose any other, which perhaps would be far inferior to it.

ARTICLE IV.

To dispute the weather gage with the enemy.

THAT you may not be exposed in this contest for the wind, which never ought to be practised but in presence of the enemy, you must take care always to be ranged in the order of battle, or of sailing on one line, that you may always be in a situation to come to action if the circumstances should require it. Being then in this order to leeward of an enemy of whom you wish to get the weather gage, your fleet is to be kept on the opposite tack to that of the enemy; because, in that position, they will be obliged to edge very much away should they be inclined to come to action, and, by that means, they may lose the advantage of the wind, which they should not run the risk of, though, strictly speaking, it may be done without laying the fleet open, as shall be shewn hereafter.

IF your enemy persists in keeping to windward, without coming to action, they will be obliged to keep upon the same tack with you, to prevent your getting into their wake, or doubling them by passing a-head and to windward, unless the whole of the weather fleet be absolutely excellent sailers, which is very rare, though not impossible. However, as fleets in general sail nearly upon an equality, it will be impossible for the lee fleet to force the other to action, without a shift of wind; which is a very common event, which every succeeding instant may bring about.

IT is of the highest importance for an Admiral to be acquainted with the positions of the coasts, as well as with the general and particular

reigning

reigning winds in the track he is likely to meet the enemy, in order to take advantage of its revolutions and changes, as well as of the alteration of the tides, as, through ſuch circumſtances as theſe, the weather gage may often be gained, and the fate of a battle decided.

OBSERVATION.

THE lee fleet may turn to windward, and purſue the enemy according to the principles of chaſing, by tacking all at the ſame time, as ſoon as the center ſhip brings the middle veſſel of the weather line exactly on her beam, in order to join them by the ſhorteſt means poſſible, without, however, deviating from the order of battle, or ſailing on one line.

ARTICLE V.

If the weather fleet be inferior, they ought to come to action while they have the advantage of the wind.

THE fleet to leeward, which is endeavouring to get to windward of the enemy, muſt keep upon the contrary tack; but the fleet to windward, which are in order of battle or of ſailing on one line, are to tack all together to get into the ſame poſition as the ſhips to leeward, then bear away ſo as to approach the lee fleet near enough for action, keeping a little a-head of them without breaking the line, to prevent their getting far enough a-head to tack and double the weather fleet's van to windward.

THIS is, in fact, the only reſource the weather fleet have under ſuch circumſtances, unleſs they have ſome place of refuge; for, if obliged to continue long in the preſence of the enemy, they will ſooner or later be obliged to come to action with much greater diſadvantage.

OBSER-

OBSERVATIONS.

If the weather fleet be in order of battle, and the wind draw a-head, the lee fleet, if they be a-head and in order of battle, ought to box off on the ſame tack as before, in order to tack in ſucceſſion in the wake one of another, to reſtore the order of battle in drawing at the ſame time a great deal to windward: this manœuvre may even be a means of weathering the enemy, if the wind ſhould ſhift much: for, they have no other method to regain the order of battle, without loſing much ground; though they will always loſe a great deal with reſpect to the poſition of the enemy to leeward.

If the lee fleet be a-ſtern, and the wind ſhifts aft, while they are on the contrary tack with the enemy in order of ſailing on one line, they ought to tack or veer all together, and at the ſame inſtant; becauſe this ſhift of wind will be a-head for all the ſhips, in reſpect to their tacks on board, and a-ſtern in reſpect to the order of battle. When the van ſhip is full on the other tack, as well as all the reſt in their former order of battle, ſhe ſhall haul by the wind, while the reſt of the fleet run large on their firſt line of battle as many points as the wind has ſhifted aft, to get into her wake ſucceſſively, and reſtore the order of battle in approaching the enemy, and gain the wind of him, and perhaps in doubling him even if the ſhift has been great: for, the only mean they have of reſtoring the line of battle is by the van ſhip hauling by the wind, and the reſt coming into her wake in ſucceſſion. If the ſhift of wind was four points, the fleet to leeward would be obliged ſtill to perform the ſame manœuvre, that they might go about, after a certain time, ſucceſſively to windward of the enemy, who could only in the mean time have tacked all together, to bring their fleet ſuddenly in a line of battle on the other board.

If, when the wind ſhifts aft, you are a-ſtern in order of battle, and the enemy be on the other tack in the order of ſailing, the leading

leading ſhip muſt haul cloſe to the wind immediately, while the other veſſels will come in ſucceſſion and bear away as many points as the wind has ſhifted, in order to perform the ſame manœuvre and reſtore the line of battle. By obſerving this mode of manœuvering, you will approach the enemy, and gain as much to windward of him as poſſible, or get even the weather gage of him entirely, if the wind has ſhifted conſiderably. The rear ſhip of the fleet to leeward may immediately keep cloſe to this new wind on the ſame board, while all the reſt of the fleet, after having tacked together and at the ſame time, will come and place themſelves cloſe by the wind in her wake, where they are again to tack ſucceſſively, in order to follow their rear ſhip, which is now become the leader, and which may break the enemy's line, or at leaſt gain the wind of him. But, to be able to go through this evolution, you muſt have nothing to fear from the enemy; for, the fleet will be obliged to go about twice before the order of battle can be reſtored. The weather fleet ought to keep their wind as cloſe as poſſible, holding the enemy always exactly to leeward of them, by keeping on the ſame tack as he; and if the wind ſhifts a little, and becomes favourable to the enemy which is to leeward, the weather ſhips are then to keep exactly their wind, without caring for the preſervation of the line, unleſs the two fleets be abſolutely very near one another.

ARTICLE VI.

To avoid coming to action when to windward.

THE weather fleet having it always in their power to preſerve* their advantage, can but with difficulty be forced to action; becauſe they

* Unleſs the wind changes.

they may always hold the board on which they most recede from the enemy; while the fleet to leeward must run in the order of sailing on one line, or in order of battle on the other tack, until their Admiral have the center ship, or Admiral, of the weather line, right a-breast of him, and perpendicular to his course, in order to tack all together and follow the weather fleet by the principles of chasing. For, if the lee fleet stand on one tack till they can weather the retreating fleet, they will soon be out of sight, since fleets in general sail nearly with equal celerity.

OBSERVATIONS.

The weather fleet may fly off in order of battle on the starboard or larboard tack, while the lee fleet pursues them in the same manner, that is to say, in order of battle likewise and on either tack. But when they come to go about, they are to hold the order of sailing. If the lee fleet is so much superior to the weather fleet, as to be able to form a detachment of fine sailing ships, in a sufficient number to attempt any thing, let it be done; then this squadron is to chase the flying enemy to winward, in the same manner as one single ship chases another over which she has the advantage in sailing; while the remaining part of the superior fleet will use every possible effort to get to windward, as we said before.

By this manœuvre, the detachment of the swift going vessels having joined the enemy, will harass and disturb their movements, besides keeping them in sight of the rest of the fleet, which will then have the superiority in sailing; for, when you are engaged in an action, or when some of your ships are disabled, it is impossible to manœuver properly unless such ships be abandoned; and then it becomes impossible to get out of sight of a superior fleet which takes that resolution.

REMARK.

If the constancy of the winds could be depended upon, the weather fleet might, with impunity, preserve their advantage in presence

presence of the enemy, were he not sufficiently strong to detach a squadron of superior sailers. But, as nothing is more frequent and common than the variation of the wind, it is always best to keep as far as possible out of sight of a powerful adversary, when you do not find yourself absolutely in a situation to fight: and, on the contrary, the fleet inclined to come to action ought to keep in sight and as near as possible, keeping always on the same board as the enemy, in order to catch the opportunity of the first shift of wind to force him to battle.

ARTICLE VII.

To avoid coming to action when to leeward.

THE lee fleet, which is wishing as much as possible to avoid an engagement, ought to form the order of retreat, to fly from the enemy if they are in view of him, and run on the same tack as their chaser. But, if he is yet out of sight, and they have intelligence of his approach by their frigates, which are looking out, they may run large from the hostile fleet, without confining themselves to keep the wind exactly aft, unless they be in the order of retreat.

OBSERVATION.

THERE are circumstances when the lee fleet may run with the wind aft, without assuming the order of retreat; as, for example, when they wish to gain time, or come to action upon the enemy persisting obstinately in his pursuit of them. These extraordinary cases excepted, a fleet never ought to fly before the enemy, without being in the order of retreat, as the rear is then in the best situation to extricate themselves in case of accident.

ARTICLE VIII.

To force the enemy to action when you are to windward.

It has already been made evidently appear that, when you are in presence of the enemy, an engagement is almost unavoidable. The lee fleet, which is wishing to come at any rate to action, have therefore, in that case, need of nothing but patience; for, in keeping always on the same tack with the weather fleet, and taking care to have them so exactly a-breast as to prevent the least danger of losing sight of them, you are ready to take advantage of the first favourable shift of wind to make the attack.

Night is certainly the time when an alteration of course may best be attempted. But, the lee fleet is to have frigates on the look out, which, by signals, will continually give notice of the manœuvre and course of the retreating fleet to windward, which, by these means, is always exposed to be pursued without being able to get off unseen, and must, sooner or later, be compelled to come to action, unless they can get into some port, or a gale of wind should come to rescue them by dispersing both fleets, and thus furnish the means of retreating in a storm.

OBSERVATION.

It is easy to conceive that the lee fleet cannot fail bringing the weather line to action, unless the commanding officer of the armament should take the resolution not to fight but with the weather gage; which will not be easily gained without a shift of wind, or a very great superiority of sailing.

ARTICLE IX.

To force the enemy to action when you have the weather gage; or, the way to approach, in the best order, near enough for battle.

If the lee fleet keep close to the wind in order of battle, with the design of bringing the weather line to action, the fleet to windward

are

are to ſtand on in the ſame manner till they are a-breaſt of the enemy; then, they are all together, and at the ſame time, to bear away, and ſteer exactly ſo as to bring their reſpective opponents in the adverſe line, on the ſame rhomb of the compaſs with them, in obſerving the principles of chaſing, which are to be obſerved by every chaſer to windward. By that mean the fleets will ſoon be near enough to begin the action, in preſenting the bow of each ſhip to her opponent in the order of ſailing, which will be eaſily changed for the line of battle, by all the ſhips hauling cloſe to the wind together, in the moment which precedes the beginning of the action.

OBSERVATIONS.

THE fleet to leeward, inclined to engage, might bring-to to prevent loſing time; as, by this manœuvre, leſs time will be requiſite for the weather fleet to join them: then they will file as ſoon as the action begins, becauſe it is more favourable to a lee line to be advancing a-head; ſince, if a ſhip be diſabled in the weather line (which is obliged to follow with the top-ſails full), ſhe will infallibly drop, and run foul of the next veſſel a-ſtern of her, covered with fire and ſmoak, which may be productive of great diſorder in the fleet, as was the caſe with the Britiſh fleet in the year 1756, in the action off *Minorca.*

As the lee fleet file and ſtand on cloſe by the wind, it is neceſſary that the weather line ſhould be a-breaſt and parallel to the other, before they bear away to come within the requiſite diſtance for action; in order that the van ſhip of the weather fleet ſhould always keep to windward of the leading ſhip of the lee line, and be guarded againſt ſuch a ſhift of wind as might come a-head; which would not be the caſe if they were a-ſtern of the van ſhip in the lee fleet, which would be able then to double them to windward, as well as the reſt of the line, by tacking in ſucceſſion.

ANOTHER reaſon for the weather line being right a-breaſt of the enemy to leeward, and for every ſhip ſteering on the ſame point in approaching her opponent in the adverſe line of battle, under their lee, is, that the fleets may be placed exactly parallel to each other; for, as the weather line muſt not be a-ſtern, becauſe of the riſk of the winds coming more forward, neither muſt they be a-head of the line to leeward, leſt the wind ſhould come more aft; for then, the lee fleet keeping cloſe by the wind in the wake of their leading ſhip, might, by this ſhift, be as far to windward as the oppoſing fleet, or even get the weather gage of them.

BUT if the weather fleet keep exactly a-breaſt of the other, they will always be in a ſituation to preſerve their advantage, without expoſing themſelves. It is, notwithſtanding, true, that thoſe ſhips keeping more away than the line to leeward, will find themſelves, when come within gun-ſhot, in a very diſagreeable ſituation, with reſpect to the enemy's ſhips, which will have it then in their power to enfilade them obliquely, and fire on their bow as they bear down; which may throw much diſorder among the ſhips of the weather line, which for that moment have it not in their power to fire their whole broadſide at the enemy, who has the advantage of beginning the action.

IF the lee fleet bear up 45°, or four points, to move their order of battle on the other tack and avoid the action, filing off in ſucceſſion in the wake of the van ſhip; the weather line, by bearing up all together, and at the ſame inſtant, eight points, to preſerve the order of battle, cannot fail (both fleets being ſuppoſed to ſail equally) to paſs through the middle of their line, and force them to fight with diſadvantage, if their extent be double the diſtance between the two fleets; for, if they be leſs numerous, they will not be ſo ſoon engaged, becauſe it will be more difficult to cut off any part of them than if the line had four leagues extent, and the diſtance between the fleets only two. A ſquadron, whoſe extent

ſhould

ſhould not exceed two thirds of a league, would (ſuppoſing an equality of ſailing) be able to file off in one half of the time the other would take to join them; but, the weather fleet would ſtill have approached them two thirds of a league.

If the lee fleet bear up four points all together, and at the ſame inſtant, being of equal extent with the line to windward, and their diſtance from each other equal to half the length of one of the files, ſhould the weather fleet bear up at the ſame time eight points, they will approach very near, it is true, the ſtern-moſt of the retreating fleet; but they will not have it in their power to cut any of that fleet off, even with an equality of ſailing: ſo that the only advantage gained by this manœuvre will be an ability of attacking the rear, and bringing it to action.

If the van ſhip and the reſt of the weather fleet had a ſufficient velocity to keep the center ſhip of the lee line on the ſame point of bearing; in that caſe, the leading ſhip may break through the enemy's line about the middle ſhip of the center diviſion; for, ſuppoſing the fleets in order of battle, on the ſtarboard tack, ſteering Eaſt with the wind at SSE, being at two leagues diſtance from each other, both the files being four leagues in extent; the lee line bearing away all together four points large, will run NE, while that to windward, bearing up all together and at the ſame inſtant, will ſteer North, the van ſhip of which will keep the center diviſion of the lee line on the point of bearing NW: as ſhe is ſuppoſed to be able to continue in this poſition, it follows, the van of the weather file muſt cloſe the center of the flying line to leeward, after having run four leagues. The time and diſtance neceſſary to cut off a retreating fleet may always be known, according to the laſt ſuppoſition; becauſe, by the bearing of the two ſhips from the van to the center, we have the baſis of a triangle which will be compleatly formed by the two courſes ſteered by theſe two ſhips, and in which two angles and one ſide at leaſt will always be known; which is

full

full ſufficient to find the reſt, and conſequently to judge the diſtance to be run before cloſing the enemy.

Should the lee fleet get upon the other tack, and run large, ſtill preſerving the order of battle, they will be ſtill ſooner cloſed, and forced to action by the weather fleet, who have only to keep away from eight to nine points on the ſame tack, or run right before the wind.

The weather fleet can always force the lee one to action, whatever movements they make: for, if they run with the wind right aft, in order of battle, they cannot (in ſuppoſing an equality of ſailing) avoid being cloſed, or broken nearly about the center by the weather line, which has only to ſteer two points on each tack nearer the wind than the retreating fleet. So that the rear of the weather file, having borne up no more than eight points, will find, at the end of a certain time, to have approached extremely the center of the retreating fleet, and, in a ſhort time more, will be able to bring their rear to action.

The weather fleet have yet another advantage; becauſe, as their ſhips have the wind on the quarter, they ſail with greater celerity than thoſe of the lee fleet, which run before the wind. The lee fleet being abſolutely determined to fly, has therefore no other expedient left to prolong time, but to combat in the order of retreat, right before the wind, or on the ſame courſe as the purſuing fleet; for, other advantages are not to be depended on, if purſued by a victorious foe, and one of that ſpecies, too ſeldom found, who let nothing eſcape them which is any way favourable to them.

If, from all that has been ſaid, it reſults that it is not poſſible for a fleet of equal force to avoid an action, how then muſt it be with one much inferior? The more numerous has nothing to do but to form a detachment of ſuperior ſailers, which will chaſe ſtrait before them and begin the action, while ſome others approach to finiſh it. Whence we may conclude that, when in preſence of too

powerful

powerful an enemy, it will never be poſſible to avoid an action, if he is determined to come to one.

ARTICLE X.

To double the enemy when ſuperior to him, and to leeward of him.

The lee fleet having the ſuperiority in number, ought to endeavour to range exactly a-breaſt and parallel to the weather file, ſo that the van or rear may extend beyond their line, in order to over-reach them, by tacking in ſucceſſion to double to windward their van or rear, and bring them between two fires. Provided this manœuvre be properly executed, it will be impoſſible for the ſhips in the weather line, thus preſſed, to continue long in their poſts; for, there is no veſſel cloſely attacked by two others of equal force which can long reſiſt being overcome; ſince it is always in the power of one of them to get into ſuch a poſition as to be able, without much danger on her ſide, to deſtroy the enemy in a very ſhort time.

But the queſtion here to be diſcuſſed is, "Whether the moſt "advantageous evolution is to double the van or the rear?" for, both the one and the other have, in reality, ſo conſiderable an advantage, that either of them may in a very little time determine the fate of a battle.

If the fleet with which you are engaged be to windward, either their van or their rear may be doubled; but, the van may with the greateſt facility; becauſe, if they are engaged by the ſhips a-breaſt of them, thoſe which are advanced a-head will be able, by making all ſail, to get on the perpendicular to the direction of the wind of the van of the enemy, and tack in ſucceſſion to gain the wind of them on the other board, in keeping them to leeward of them: and, when they are come ſufficiently to windward, they are again to go about, in order to keep the two head-moſt ſhips of the enemy's line continually

nually under their fire. If there be two or three ſhips to tack in ſucceſſion and gain the wind of the enemy, they may edge down on the van of the weather line at pleaſure, in keeping themſelves a little to windward of her; and, as that van-guard is already engaged by the other ſhips a-breaſt on the other ſide, ſhe muſt neceſſarily be ſoon diſabled. If they bear up, they muſt drop upon the line with which they are engaged to leeward, while the ſhips to windward ſtill continue to cannonade them. If they attempt going about, in order to attack more cloſely the ſhips to windward, they will be raked, while in ſtays, by their opponents to leeward and to windward, who enfilading them with whole broadſides, which they cannot return, muſt abſolutely put a finiſhing ſtroke to their diſorder. If they make ſail in order to fruſtrate the deſign of the ſhips inclined to double, thoſe with which they are engaged a-breaſt to leeward have only to perform the ſame manœuvre, and keep them under their fire; while the others, after having haraſſed them as much as poſſible, will do their beſt to perform the ſame manœuvre on the ſucceeding ſhips.

The Captains deſtined to double the enemy ought to be men of known ability in the manœuvering of ſhips, as well as of approved courage. They will not be ordered upon that expedition but by a weather fit for ſailing at the rate of three knots an hour: and, for the greater promptitude and certainty of ſucceſs, none but the beſt going ſhips are to be employed in that ſort of manœuvre.

If any of the ſhips in the van of the weather line happen to be diſabled in their maſts or yards, as will undoubtedly be the caſe after having been between two fires, they will drop a-ſtern and run foul of the next which follows, and theſe again of their ſubſequent comrades; at laſt, diſorder will become prevalent, by ſhips running foul of each other, or manœuvering to avoid the ſame accident; ſo that the order of battle will be broke, while, on the other hand, the line to leeward is preſerved with all the advantage poſſible. The ſhips

ſhips which have gained the wind of the enemy, in continuing their manœuvre will augment the confuſion, and engage, however, no more than they like: and, if by chance or misfortune they ſhould be crippled, it will not certainly be an eaſy matter for them to extricate themſelves. But as they may, on the other tack, drop a-ſtern to windward of the enemy's line, or veer again like him, they muſt extricate themſelves as well as they can, and always advantageouſly enough, if, by doubling the van-guard, they are able to throw it into diſorder.

If the rear of the lee fleet be extended beyond the ſtern-moſt ſhip of the weather line, they will be obliged, if they want to double the rear of the enemy to windward, to make ſail and tack in ſucceſſion; in which manœuvre, the head-moſt ſhip of thoſe deſtined for this ſervice is to go about firſt: then, continuing to keep up a briſk cannonade as they come to the wind, they will go and heave about again a little to windward of the rear of the enemy, in order to bring their ſtern ſhips between two fires; and, ſhould they have the good fortune to oblige them to bear up, they muſt go on ſucceſſively from one ſhip to another, as long as they find they ſucceed in forcing them to give way. Should diſorder take place in the rear of the weather fleet, it will not be near ſo prejudicial to the enemy as if it had happened in the van; on the contrary, it may turn out to be of ſome advantage to them. But the veſſels combating to windward can eaſily withdraw from the fight, by backing a-ſtern, when they find themſelves too hard preſſed.

OBSERVATION.

Before proceeding any farther, it may not be amiſs to remark, that ſhips diſmaſted, or even deprived of the uſe of a top-ſail in the weather line, cannot without great riſk retire from the order of battle (when under neceſſity to do ſo), nor paſs to windward of their rear, in order to refit; for, veſſels ſo circumſtanced cannot

ſtay; and even if they could, their ſtern would be for a great while expoſed to the enemy, who, in that poſition, would ſoon render them motionleſs, by compleatly deſtroying the little rigging they had left.

If ſuch ſhips be obliged to veer, that manœuvre making them approach nearer the enemy, they cannot avoid preſenting their head to their opponent, a ſituation ſo dangerous that nothing more is wanting to compleat their total deſtruction. But, ſuppoſing them able to finiſh their evolution, they will not have it in their power to paſs to windward of their ſecond a-ſtern, without running foul of her: for, one hundred fathoms diſtance between the one and the other ſhips, are not ſufficient to give a diſabled veſſel, which has dropt above fifty fathoms to leeward in veering, ſufficient time to gain to windward the diſtance neceſſary to paſs a-head of the ſhip which immediately follows. Nothing but boats can therefore aſſiſt her, by towing, to get under cover: and yet it will not be executed without undergoing a very heavy fire from the enemy. If it be a van ſhip which is diſabled, being doubled to windward by one or two of the lee line, it will be impoſſible for her to diſengage herſelf: for, the two ſhips which have gained the wind of her will not leave her, nor ſuffer her to receive the leaſt aſſiſtance from the boats or frigates which may be ſent to her relief; and, ſhould the fleet ſhe belongs to bear up and paſs to leeward of her, which is the only manœuvre they have to execute in ſimilar circumſtances, the diſabled veſſel will be ſacrificed, they being unable, without the utmoſt difficulty, to give her the ſmalleſt aſſiſtance; for, every ſhip is engaged by the opponent which is a-breaſt of her, and the leaſt remiſſion of their fire, by fighting on the other ſide to aſſiſt, as they paſs, the diſabled ſhip, would give the lee enemy a decided advantage.

ARTICLE

ARTICLE XI.

To double the enemy when to windward of him.

The ſhips of the weather line, having extended their van beyond that of the lee file, are to veer, in order to bring the head-moſt ſhips of the enemy's order of battle between two fires. But, let them do as they will, there never can reſult ſo much advantage from this manœuvre as when doubling a fleet to windward; becauſe, the diſabled ſhips can always veer with facility. True it is, they cannot fail becoming at the ſame time the prey of the enemy; for, both thoſe which have doubled them, and thoſe with which they are engaged a-breaſt in the weather line, will always have it in their power jointly to preſs as cloſe upon them as they think proper.

If the ſhips which have doubled the van of the lee fleet, with which they are engaged, be diſabled, they will be obliged, as they cannot make ſail, to paſs along the lee line; and they cannot eſcape being totally deſtroyed, if they do not bear up before the wind to get out of gun-ſhot; during which manœuvre they cannot avoid being ſtill in a very diſagreeable ſituation.

Should the ſtern-moſt ſhips of the weather fleet be diſabled, in doubling the enemy's rear, they have only, if they want to extricate themſelves, to drop a-ſtern, and let the two fleets advance a-head; and, after having refitted themſelves, they will re-aſſume their poſts.

REMARK.

It has been propoſed, to avoid being doubled by a fleet ſuperior in numbers, to leave ſpaces in the length of the line, or to place the ſhips at ſuch a diſtance from each other, as to render the length of the inferior file equal to that of the order of battle, which is ſuperior in point of number of veſſels. But neither theſe manœuvres, nor any other of the ſort which might be contrived on that ſubject, will

ever be of any ſervice, if you have to do with opponents of ſkill and ability; for, theſe will always diſpoſe their ſhips in ſuch a manner, that ſeveral ſhips of the inferior fleet will receive the fire of many at once, and will conſequently be obliged ſoon to give way, or ſtrike.*

ARTICLE XII.

To force or traverſe the enemy's line.

THIS is a manœuvre the lee fleet may execute to gain the advantage of the wind. It is performed by the van ſhip tacking when perpendicular to the direction of the wind of the center ſhip of the weather line you mean to traverſe; then all the file goes through the ſame evolution ſucceſſively, when within gun-ſhot; ſo that you may paſs through the center of the enemy's line, or perhaps a little more towards the enemy's van, to go about again in ſucceſſion to windward of him. But, as he will not be long, without doubt, before he performs the ſame manœuvre, he will thus be able to regain the wind, if you do not force him to give way under your fire before his evolution is finiſhed. The enemy to windward may even cauſe his van ſhip to tack, as well as the reſt of the van-guard to follow in ſucceſſion, as ſoon as the leading ſhip of the lee fleet ſhall have paſſed through his line and be ready to go about, by which means he will bring them between two fires. This manœuvre well executed might perhaps give no little trouble to the ſhip attempting to force the line.

OBSERVATIONS.

THIS evolution may be performed with advantage, if, by ſome accident or fault in the manœuvering, the center diviſion of the weather

* Or perhaps go to the bottom.

weather line be ſeparated from their van or rear. For example, when the center diviſion to windward is incumbered with diſabled ſhips, then thoſe of the center diviſion to leeward are, with all ſails ſet, to tack in ſucceſſion, and force with promptitude through the weather fleet, to augment their diſorder, leaving their own van diviſion to engage that of the enemy on the other tack.

ARTICLE XIII.

To prevent the line being forced.

When the lee fleet go about ſucceſſively, in order to traverſe the enemy, the whole line to windward are to tack together and at the ſame time, to get upon the ſame board as the enemy, who will neither be able to join nor to traverſe them.

To perform this evolution with advantage, you muſt let ſome of the van ſhips of the traverſing fleet paſs to windward, then go all rapidly about, in order to put and keep them between two fires; thus you may ſucceed in deſtroying them, without their own fleet being able to give them any effectual aſſiſtance.

OBSERVATION.

It is eaſy to perceive from what has been ſaid, that there is little occaſion to fear being traverſed, as ſuch a manœuvre may turn to be more prejudicial than advantageous to thoſe who perform it. Nevertheleſs, it may and ought to be put in practice when the weather fleet leave ſuch vacancies between their diviſions as to allow ſome ſhips of the lee file to be inactive. In this caſe, the ſhips which are without opponents a-breaſt of them are made to tack, with all ſails ſet, in ſucceſſion, and paſs through theſe intervals of the weather line, in order to double the center diviſion, or any other part of it, and bring it between two fires; while the other

ſhips

ſhips which are a-breaſt, and on the other ſide of it, cannonade from to leeward.

ARTICLE XIV.

To bring a fleet to an anchor.

A CONSIDERABLE fleet ought to anchor in three parallel lines, at the proper diſtance which the length of the columns generally require. The ſhips being a hundred fathoms from each other, in the line of their head-moſt ſhip, which is to be on one of the cloſe hauled lines of bearing; the van and rear of the columns are to correſpond with each other exactly in the direction of the wind, that they may with eaſe get under way, and form the order of battle with facility, ſo as to be able to diſpute the weather gage with the enemy, if there ſhould come one. As this evolution is to be performed in moderate weather, the fleet being in order on three columns, they are all at the ſame time to bring their ſhips head to wind under their top-ſails, and let go their anchors together, in clewing up the top-ſails, with all poſſible diſpatch, head to wind; putting the foot of the ſails in the tops, and looſening the ſheets before hauling them down; then veering away an equal quantity of cable, to preſerve their diſtances.

OBSERVATIONS.

WHEN it blows ſo freſh as to require the top-ſails being reefed, two cables length diſtance may be kept between the ſhips, and even three if it be likely to blow hard.

IF the fleet do not exceed twenty ſhips, they may anchor on one of the lines of bearing, or parallel to the coaſt, in places where trade winds are common, provided they blow in the direction of the land; for, in all caſes, they muſt be in a condition to get under way at the firſt ſight of the enemy, whoſe approach is never to be

waited

waited for at an anchor; becauſe, if it be dangerous for a ſingle ſhip, it muſt be ſtill more ſo for a fleet, the movements of which are interrupted by the difficulty there is in getting with celerity under way ſhips which are moored, and which, in that caſe, are not much able mutually to ſupport one another, as it is abſolutely requiſite in a fleet.

ARTICLE XV.

To get a fleet under way.

All the fleet being ſhort a-peek, the lee column is to get under way firſt, and bring-to all at the ſame time, juſt as they find themſelves after caſting. The center column is then to perform the ſame manœuvre, and caſt likewiſe as ſoon as the other column is brought-to; and both columns will remain in that ſame poſition of lying-to as the lee file, till the weather column which is ſtill a-peek, having weighed, ſhould be alſo under way.

OBSERVATIONS.

The three columns may often be got under way all at once: but, to execute this, the fleet muſt all act together, and with equal ardour; for, the weather ſhips muſt not at any rate be under way before the lee ones.

If it be neceſſary to get immediately in order of battle, the weather columns are at once to bear up two points together, that they may take their poſts in the line of battle a-head of the third column.

If the fleet be moored on a line and head to wind, the rear ſhip may get under way firſt, and haul immediately by the wind; the others, in ſucceſſion, from the rear to the van, can eaſily take their ſtation in her wake, ſo that the rear ſhip will become leader.

If the fleet be moored in a line head to wind, they may all get under way at the ſame time; but the van ſhip is to bring-to, while the

the reſt, caſting the other way, would ſtand on by the wind on the ſame tack on which they have caſt, and come to tack ſucceſſively in her wake, to form the order of battle.

If you wiſhed to be more to windward, the fleet having all at the ſame time got under way, and caſt all on the ſame tack, the van ſhip might heave about under an eaſy ſail; and all the reſt, continuing cloſe hauled on the ſame tack they got under way, will come, in ſucceſſion, in his wake, when they are to ſtay. Obſerve, at the ſame time, the rear ſhips are to carry all poſſible ſail.

ARTICLE XVI.

To put a fleet in a poſition of defence in a road-ſtead.

When a road-ſtead is ſufficiently ſpacious, and the entrance not too much extended, the ſhips are to be moored with ſprings, in two parallel lines from the entrance to the bottom of the bay; the van ſhip ſo near the land that it ſhould be impoſſible for the enemy to paſs between them and the ſhore, and he may be obliged to paſs between the two lines, the van ſhips of which muſt be ſupported by good batteries on ſhore, at the two extremities of the boom, which they muſt take care to have conſtructed from one ſide to the other, when poſſible, or only before the ſhips if it cannot be done otherwiſe. Beſides this, there are to be gun-boats deſtined to poſt themſelves at pleaſure a-head or a-ſtern of the ſhips attempting to force the port. There are alſo to be fire-ſhips moored within the points, that they may be to windward of the enemy after they have got into the port, ſuppoſing them to have been able to force the entrance.

ARTICLE XVII.

Reflections on the beſt method of fighting at ſea.

Boarding ever was, for the French, the moſt advantageous method of fighting. In the Second Part of this Work, I have treated

treated very minutely on the manœuvres of boarding between two ſingle ſhips. In the Third Part, I have entered into the particulars both of the diſpoſitions of the ſhip, and the exerciſe of the crew, which are requiſite to effectuate boarding. There remains therefore for me, in the preſent Part, but to give it as a rule that our fleets and ſquadrons ſhould adopt that mode of fighting which is ſo deciſive for us: in which caſe, this is the method I would recommend to put it in execution.

When, with an equality of forces, you find yourſelf to windward of your enemy, and able to attack him by drawing near, within piſtol-ſhot of him, according to the principle heretofore laid down, and ſo as not to be enfiladed, as we have explained it already, the Admiral ſhould give the ſignal for boarding at the ſame time as he gives that for beginning the engagement, provided the enemy has not begun to fire firſt. Then, each ſhip, under the protection of a ſtrong and well-ſerved fire on its ſide, would manœuver the proper way for boarding her opponent in the hoſtile line, without ſtriking her ſprit-ſail, for fear of diſcovering her intention. This bold and unexpected movement being executed at one and the ſame inſtant, throughout the whole fleet or ſquadron, could not but be very advantageous to the aſſailants, ſhould there even be only a part of that general boarding which turned out ſucceſsfully; becauſe, ſuch of the ſhips as ſhould have met with ſucceſs would, however, take away from the enemy a portion of their force, and ſuch as ſhould have been repelled would have, in all likelihood, done as much damage to the enemy as they might have received, and might alſo, in the end, be ſupported by thoſe of their comrades which ſhould have been conquerors. To conclude, I declare it here then as my firm opinion, that ſuch an attempt can in no wiſe be diſadvantageous, eſpecially if, in ſuch a buſineſs, care is taken never to oppoſe to the enemy any but ſhips of equal force.

When you are inferior in point of number, boarding is again the only expedient you can take; as it is the only reſource of the feeble

to ſhew audacity, and the only glorious manœuvre which can be reſolved upon. It is received as a fact, no longer to be diſputed, that you can be but worſted if you ſpend your time in cannonading.

If you are the ſtrongeſt, boarding is the quickeſt method of putting an end to an engagement. By that mean you ſpare your men and the maſtings of your ſquadron, which is much leſs in danger of being diſabled in ſuch an attack, than when expoſed to your enemy's broad-ſide firing. In a word, I am fully perſuaded that BOARDING is the only method of fighting in which the French can come off with honour, advantage, and glory.*

ARTICLE XVIII.

Of the convoy of merchant ſhips, under the protection of men of war.

To take the requiſite care of a large fleet, there ſhould be in the convoy a number of frigates, which are to be diſtributed a-head, a-ſtern, and on the wings of the fleet, who are always to be kept in the order of convoy on three, four, five, or ſix columns, according to the number it may be compoſed of: ſome other frigates are alſo to be ſent on the look-out, in order to be informed of what paſſes at a certain diſtance, and warned in good time of the approach of the enemy.

If the frigates which are ſent to look out, ſhould diſcover an enemy of ſuperior force, they will make it known by ſignal, and ſteer a different courſe from that of the fleet, in order to deceive the hoſtile ſhips in ſight.

The men of war are to hold themſelves in the order of convoy a little a-head and to windward of the weather column of the fleet; becauſe, in that poſition, they will be able with promptitude to attend

* And why ſhould it not be the ſame for any other nation?

attend wherever their presence may be necessary. The frigates will repeat the signals from one to another with celerity and exactness, that their purport may, with all possible celerity, be made known to the commanding officer, who, on the other hand, must not neglect to have all suspicious and neuter ships chased, and even stopped, by the frigates about him, and which are always to be supported by one or two line-of-battle ships, according to the exigency of circumstances.

THE degree of celerity in the progress of the whole fleet will be regulated by that of the worst-going ships, which, however, are to be abandoned when found to cause too great a loss of time; for, sometimes it is better to risk a small loss, than to expose the whole by delay.

THERE will be placed between the columns, sloops of war, and other swift-sailing light vessels, to maintain order, and keep the ships in their stations. Their particular business will be to get the tardy ships to make more sail, and to oblige those which may be out of their post to resume it; in the evening they will give an account, to the frigates having charge of going the round, of those which have not well manœuvered; and these will make their report to the Commodore.

DURING the night the same order will be maintained, except with respect to the look-out frigates, which are to be called in within a certain distance of the fleet, and which are to be allowed lights as well as the rest of the men of war. They are to be particularly careful to oblige all straggling ships to return to the convoy, and to fire, without hesitating, on all strange vessels coming from the main sea, in order to give the alarm. Every night they are to be supported on the wings by some line-of-battle ships.

ARTICLE XIX.

To force the entrance of a port.

THE attack of the entrance of a well-defended port may be considered as a piece of the moſt exquiſite refinement, ſkill, and intrepidity, in the art of manœuvering: for, to execute it with any degree of certitude in the ſucceſs, a great knowledge of the ſtrength and ſituation of the place you are going to attack is abſolutely neceſſary, that your diſpoſitions may be made accordingly, by diſtributing, on a plan of attack, the ſhips of the line, frigates, bomb-ketches, and fire-ſhips, to the greateſt advantage poſſible, that not only they may be but little expoſed to the batteries which defend the port, but alſo able, on the contrary, to deſtroy them and facilitate the paſſage. I am well aware that there are ports, the attack of which by ſea may be looked upon as impoſſible, on account of the force of their garriſon, of the elevation and proximity of batteries of all kinds, which may be eſtabliſhed on both ſides of a narrow entrance, which may be farther fortified by a boom, ſupported by batteries at each extremity, as well as by men of war, fire-ſhips, and gun-boats, properly diſpoſed; in ſhort, by all the means which naval and military war can offer to the imagination of officers of experience and ability, who have at heart to defend a poſt with which they were intruſted. But, as, by the help of marine forces, there are a number of ways by which fortifications, of the beſt and moſt ſkilful conſtruction, on ſhore and along the coaſt, may be attacked; we are going to treat in general of that ſubject, without confining ourſelves to a ſingle occurrence, which can never be concluſive for all occaſions, when we come to conſider the almoſt infinite diverſity of places and ſituations which may be met with.

WE have but few examples of harbours being forced when well fortified and defended. We ſhall, however, mention the

entrance

entrance* of *Rio-Janeiro*, in *Brasil*, which the celebrated GUAY TROUIN forced in the order of convoy on one line, with his line-of-battle ſhips a-head, and the frigates and ſtore-ſhips bringing up the rear.

THIS action† alone is ſufficient to prove that the entrance of any port, which has no other fortification than batteries of cannon, may at any time be forced, when aſſiſted by a favourable wind to penetrate into it. For, there is not a line-of-battle ſhip but can ſupport the firſt fire of a battery on ſhore, which ſhe with vivacity returns as ſhe paſſes, beſides her being ſupported by her comrades a-ſtern, which begin to open their fire nearly at the ſame time, in ſucceeding one another with promptitude, ſince there ought not to be above one hundred fathoms between a ſhip and her ſecond. Therefore, ſuppoſing there might be even no more than twenty ſail of the line to paſs a battery, it follows, that the rear ſhips, which are always the weakeſt, will not receive a very heavy fire, as the batteries on ſhore muſt be extremely ſhattered after being expoſed to ſo heavy a cannonade, particularly if the ſhips were near‡ enough, and ſerved their fire with ſhot and langrage; for, otherwiſe, they could not be much injured.

AFTER all, guns on ſhore are not ſo conſiderable an obſtacle to the paſſage; for, a ſhip advances with great celerity, and hardly any but

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* The Author ſhould not have forgotten here that moſt eminent tranſaction of the ſame kind by SIR GEORGE ROOKE, at *Vigo*, in the year 1702.

† That of SIR GEORGE ROOKE will prove alſo that neither a boom, nor the moſt able diſpoſition of things, is proof againſt ſteady ability and reſolution, when ſeconded by a leading gale, as the gallant HOPSON, in the *Torbay*, clearly evinced on that occaſion.

‡ A cable's length, or leſs, is the meaſure, in which caſe no fort can withſtand their fire (red-hot ſhot apart). But, if the diſtance exceed a hundred fathoms, the batteries will not be ſo materially damaged.

but the firſt four or five ſhips can ſuffer conſiderably from the enemy's cannon: the very reaſon why ſuch care is taken to employ the heavieſt ſhips in the van, and to take advantage of a fair wind and tide, without letting the land enemy have time to recollect themſelves, and ſeizing the firſt moment of ſurpriſe occaſioned by the ſudden appearance of a fleet, the rapid movements of which cannot be foreſeen to be intended ſooner for one particular part of the coaſt than another, if they are all of a nature to be equally choſen by the fleet for directing the attack upon. But the neck, or narrow entrance of a port, forced under ſail, has interior batteries which are perpetually ſucceeding one another, and the firſt fire of which the firſt ſhips a-head are inceſſantly expoſed to endure. This ſervice is ſevere undoubtedly, and of long ſtanding out; but, after all, it is not ſuch an obſtacle as not to be overcome; and certainly conqueſt cannot be expected without ſtriking a blow; for nothing is ſo natural as to expect to meet with as good a defence as you make an attack. The ſecond batteries muſt then be cleared like the firſt, &c. &c.

If the neck, or entrance of a road-ſtead, harbour, or bay, be ſufficiently wide for two ſhips to enter a-breaſt without encumbering each other, the mouth of the port may be forced in the order of convoy in two columns, the ſtrongeſt and heavieſt ſhips leading, as they can beſt ſuſtain the firſt fire, which, in theſe circumſtances, is the moſt dangerous. Then the fleet is to be formed in the order of convoy on two lines, if the paſſage and the depth of the water permit; becauſe, then the ſhips will be expoſed to the fire of the land batteries but on one ſide only, and by that mean the riſk of every ſhip will conſequently be nearly one half diminiſhed. But, in either of theſe two circumſtances of attack, the Admiral ought perfectly to know the poſt he means to inſult, the forces of the enemy, the diſpoſition of their batteries on ſhore, the face of the country, and the ſituation of the coaſt; that he may be able to judge

judge of the value of the obſtacles he has to ſurmount, and foreſee, conſequently, the diſpoſitions he will be obliged to give his ſhips, and preſcribe beforehand to every one in particular her manœuvre, and what ſhe is to do during and after the attack. He is further to inform them, alſo, that if in the entrance any of the ſhips of the van, or others, ſhould be diſmaſted or ſunk, thoſe which follow next are to paſs a little to windward or leeward of her, without ſtopping, ſtill puſhing their aim, and cloſing the file to fill up the vacancy; warning them again, that in caſe any ſhould be diſabled, ſhe is to retire from the paſſage, in manœuvering in the beſt and moſt rapid manner in her power, that ſhe may not obſtruct her comrades; admoniſhing them all in general, to avoid, above all things, running foul of each other, rather than which they are to run a-ground on the enemy's ſhore, if it can no longer be avoided, after having defended themſelves to the laſt extremity.

When the entrance of a port is ſufficiently narrow to be traverſed by a boom, ſupported by batteries at each extremity, men of war poſted within, fire-ſhips, gun-boats, and bomb-batteries on each ſide; then the attack muſt be carried on in a different manner. Perhaps it will be found neceſſary to warp the ſhips to their ſtations; or they will be able to reach their poſts under ſail, and anchor with their ſprings, which would be more convenient and expeditious than if obliged to be hauled by means of their boats in the night. However it may be, the bombs are to be poſted as near as poſſible to the fortification they are to bombard, and ſo ſituated that the fire from the forts may act as much obliquely as circumſtances will admit, that they may be leſs incommoded in their operations. Ships are to be anchored at the ſame time with ſprings oppoſite to every battery of cannon and mortars, as well as againſt the veſſels which are placed to ſupport and defend the boom. This general attack is to be ſeconded by ſhips ready, with the utmoſt celerity, to take the poſts of ſuch as may be diſabled, and in ſuch a manner,

that

that the interval of firing may be as ſhort as poſſible. There are to be gun-boats, ſhips launches, and other boats of the fleet, manned and armed with an Officer each, to aſſiſt the ſhips in quitting or reſuming their poſts, as alſo to tow fire-ſhips clear out of the fleet. Every endeavour is to be uſed to deſtroy the epaulements of the enemy's mortar-batteries, by levelling them and ſilencing their fire; for, they are what is moſt dangerous for the ſhipping, as one bomb of thirteen inches may diſable a ſhip more than an hundred cannon-ſhot. As ſoon as it is perceived that the fire ſupporting the enemy's boom begins to ſlacken, the fire-ſhips and gun-boats are not to fail to attack them with redoubled efforts, in order to break and force a paſſage to the ſhips which defend the boom. The fire-ſhips are always to be placed to windward of the machines attacked; and, if you ſucceed in clearing the entrance, you are to heave the lead to try if there be water enough, or if there are not ſome veſſels ſunk on purpoſe to retard the paſſage of your line-of-battle ſhips, which are immediately to ſail to the attack of thoſe which defend the paſs within the boom. Theſe ſhips are to be followed by the frigates and gun-boats, which are to endeavour to take the batteries in flank. If the mouth of the harbour can be forced in this manner, the forts not yet reduced are to be abandoned, and, continuing your entrance, you make your deſcent, if it has not been made from ſome other quarter by a detachment of the fleet, as might be the caſe, ſince it is always beſt to divide the attention of the enemy, when circumſtances, poſition of the coaſt, and the acting forces, admit of it.

ARTICLE XX.

To make a deſcent in an enemy's country.

DESCENTS are generally made in roads, bays, or inlets, where the ſurf is not conſiderable: for, if the ſea run high, a landing would

would be nearly as impracticable as on a ſteep and rocky ſhore, unleſs effected by ſome lucky and unexpected event. But as we are here to ſpeak of a deſcent made openly, and by force, notwithſtanding it may be vigorouſly oppoſed, it is neceſſary that the flat-bottomed boats ſhould be ſupported, before and during their operations, by the fire from ſome ſhips. Therefore, when the Admiral ſhall have made the neceſſary diſpoſitions for the diſtribution and arrangement of the flat-bottomed boats, on board the men of war and tranſports which may have brought them, he will make them all aſſemble together at a particular place, after he ſhall have well examined the coaſt, and ſettled the plan of his real and feint attacks: then, if along ſhore, and at the place where he means to throw the greateſt part of his forces, he perceives there are barricades and ſmall batteries capable of preventing the landing of his boats, he will ſend line-of-battle ſhips, frigates, and bomb-ketches, to moor with a ſpring againſt every little battery, and every principal fort, to cannonade them with all poſſible vigour, and give them orders, at the ſame time, to redouble their fire where it is his intereſt the enemy ſhould believe he means to make the real attack.

When it is perceived that the fire from ſome of the batteries, in the places attacked, ſlackens, all the boats of the fleet improper for landing troops, are to be detached to another place to make a feint; while one fourth of the boats intended for the real deſcent, followed, within muſket-ſhot, by an equal number of ſimilar boats rowing, and ſailing if the wind permits, will go and range themſelves near the ſhips which cannonade the place where the landing is to be attempted, and by which they are to be afterwards ſupported.

When they are ranged in a line a-breaſt parallel to the coaſt they mean to attack, at about two oars length diſtance from each other, and ſupported at the center and on the wings by gun-boats, which are to take care not to get a-ground; the ſecond file is to form a-ſtern of them, in ſuch a manner that every boat may ſtem within

pistol-shot, for the middle of the interval between the boats of the first line, without any of them being a-stern of the gun-boats, who are to have room to make a stern board when they think proper, to avoid grounding, and to be able to post themselves on the wings while the flat-bottomed boats are landing. These dispositions being carefully made, all this little fleet are to pull together and with rapidity towards the shore, attentively preserving their order till they arrive at the beach. If, in spite of the fire of the ships, there be troops to receive them from behind their retrenchments, the small pieces every boat carries on her stern are to be fired; and the gun-boats, running in as far as possible, shall support them by every effort in their power, while all the boats run on shore, if the enemy give way. Then the soldiers shall leap out of the boats, the water not being higher than their knees, and form on the shore as well as circumstances will admit, and the vessels will cease firing, unless the enemy be at a distance from your troops. If the descent succeeds in this manner, the boats of the second line are, with the utmost speed, to run on shore between those of the first, and land also their troops; and, without loss of time, the whole reserve should then be sent to the place to complete the descent.

Should this first attack meet with repulse, you have nothing to do but to feign a second attempt at the same place, by adding all the rear boats to those which had formed the former attack, and giving, at the same time, the signal to the launches of the fleet's ships to come and join them, that thereby the enemy may be engaged to vacate the place for which the reserved boats are to make. When that second attack, the dispositions of which should purposely have been dragged a little in length, begins to be engaged, then the boats destined for the true and principal attack should be dispatched, with the grenadiers of the troops on board, on two lines parallel to the coasts, towards the intended spot, under the protection of the fire from the ships, frigates, and bomb-ketches, and supported

ſupported on the center, and on the wings of the gun-boats. At the very moment that, under the protection of their own fire a-head, the firſt line of theſe boats would run a-ſhore, the ſecond, with all might and main, ſhould do the ſame, in the interval between the boats of the firſt; that thereby the troops may, in proportion as they form reciprocally, aſſiſt each other in entrenching themſelves: then, all the boats of the mock attack are to be ſent for, to come with all poſſible ſpeed, with ſails and oars, and join with thoſe already landed, and increaſe the forces. The naval officers who command the flat-bottomed boats, muſt take care, as ſoon as the troops are landed, to keep their boats a-float, ready to receive and carry off the ſoldiers who might be repulſed; wherefore, they are to have their heads off ſhore, and their ſwivels ready to fire, if caſe require: as for the ſhips, they are to remain with their ſprings on, till recalled by the Admiral's ſignals.

OBSERVATIONS.

If a fleet, which I ſuppoſe to conſiſt of two hundred tranſports, more or leſs, has no occaſion to be more than two or three months at ſea; there may be put on board each ſhip of three hundred tons, deſtined to carry troops, two hundred ſoldiers, with their officers, proviſions, and ammunition neceſſary for forty days at leaſt, without reckoning the ſhip's company. Every ſhip muſt carry, beſides her long-boat, a flat-bottomed boat of thirty feet long; then, there will conſequently be, two hundred flat-bottomed boats, and a like number of launches on board this fleet.

Such an expedition requires an eſcort of at leaſt ten ſail of the line, ten frigates from twenty to thirty guns, with ſix bomb-ketches, and twenty gun-boats decked: the ſhips of the line muſt have, at leaſt, three boats, including the launch fit for this ſervice, the frigates two, and the bomb-ketches one; which will increaſe the number of boats to ſeventy-ſix. Such a convoy ſhould be ſupported, alſo, by

a fleet of obſervation, of forty or fifty ſail of the line, ſixteen frigates, and ſome fire-ſhips: with ſuch diſpoſitions there are few coaſts which might not be attacked with a moral certainty of ſucceſs.

Each flat-bottomed boat ought to be lightly built, and ſo diſpoſed as to carry fifty ſoldiers with their officers, a ſmall chaſe-gun, two gunners, ten rowers, a cock-ſwain, and one ſea-officer. According to this diſpoſition, ten thouſand men may be landed at once, in admitting, for premiſes, that the ſecond line of boats may come almoſt at the ſame time, into the intervals between the firſt, and that the coaſt (when the deſcent is made) admits of a hundred boats when they are all joined, being extended a-breaſt of each other, which is no more than ſix hundred fathoms extent, if you allow thirty-ſix feet ſpace for each boat in the line; ſo that the troops on the wings, at the greateſt diſtance from the center, on which they may fall back if requiſite, will not have above three hundred fathoms to march, and re-aſſemble in order to form in ſeveral columns, which can be done with ſo much more advantage, as they may be ſupported by the fire from the ſhips, and that of the gun-boats which are on the wings, and are at liberty to direct their fire according as circumſtances require. At the time of landing, the gun-boats of the center, are immediately to make for the wing which appears moſt in need of their aſſiſtance.

If the ſhore where the attack is formed does not admit of directing it on many places at once, or of any feints; or if the general ſhould deem it improper to divide the boats to make ſuch mock-aſſaults; all the boats of the fleet, loaded with troops, are to follow within muſket-ſhot, in order to land after the firſt deſcent, at the place appointed by the general officers. The Admiral's majors and major-adjutants ought to be provided with boats of a ſuperior ſwiftneſs, to carry his orders wherever he may think neceſſary, during the action. When the landing is effected, and the troops of the firſt deſcent are poſted, all the boats are to be expeditiouſly ſent back

back to fetch the remainder of the troops, and finish the landing; for, in such expeditions it is the rapidity of the execution which decides the success.

At landing, in the first instant of a *coup-de-main*, the fear of damaging the boat is not to be of any consideration; and they must be run stem on to the beach, without caring whether they will be stranded or not; for it is no more than must be expected in those operations which require vivacity and courage, and which always are as many occasions of triumph for the French Nation, whose natural petulancy is an incessant incitement to seek for glory, in every circumstance where activity is required for attacking.

CHAPTER VI.

A Plan of Signals.

SIGNALS are to be plain, simple, and susceptible of large extent. I do not think there ever were any so complete and perfect, in every respect, as those which were invented and practised by M. LA BOURDONAYE: he had made use of *Pendants*, as being, of all the flags, the most easy to fix to any part of a ship. It was agreed that each *Pendant* would mean a certain particular number; and that several *Pendants*, meaning each a particular number, being placed one above another, would stand as figures. Thus, it was easy to know the number of each signal, because the value of each *Pendant* was made to depend on its particular colour, as follows:

The Red Pendant was worth	1	The Red, with Blue Tail	6
The White . .	2	The White, with Blue Tail	7
The Blue . . .	3	The White, with Red Tail	8
The Yellow . .	4	The Blue, with Yellow Tail	9
The Red, with White Tail	5	The Blue, with Red Tail	0

WITH

WITH this management, an infinite number of ſignals may be contrived and varied in the ſame manner. You have only to provide three or four pendants of the ſame colour, that the ſame ſignal may be multiplied three or four times running, and produce, for example, ſuch ſignal as 33, or 444, or again 8888, and finally, all the kinds of ſignals, which may be imagined and contrived by means of numbers. Thoſe ſignals are to be hoiſted to any maſt, or yard, according as it is to ſuch or ſuch a ſhip you wiſh to ſpeak; and ſuch parts are to be preferred to hoiſt them on, which are moſt expoſed to view. The upward *Pendant*, for example, may ſignify 1, the next under it will mean 2, the next in deſcending 3, and the next 4. Therefore, having agreed that N° 170, ſhould mean, *Arm your launch for a deſcent*; that ſignal is to be made by hoiſting three *Pendants*, one above another, at the ſame gear; the firſt of which is to be *Red*, the ſecond, *White, with Blue Tail*, the third, *Yellow, with Red Tail*; and then the ſignal will be ſeen in the following form:

Red Pendant	1	170—*Arm your launch for a deſcent.*
White Pendant, with Blue Tail .	7	
Yellow Pendant, with Red Tail .	0	

SHOULD you want to make ſeveral ſignals at a time, and at the ſame gear; then each ſignal is to be ſeparated from the other by a ſmall *red* flag, without a point, which will ſerve as a coma between various ſignals.

IT will be proper to have thoſe *Pendants* of the deepeſt colours in their kinds, ſuch as dark blue, ſcarlet, orpiment, and white.

A TABLE of all the ſignals muſt be compoſed, in the firſt column of which are to be inſerted all the numbers regularly, and in their natural

natural order; in the ſecond column is to be ſet down in the alphabetical order what each ſignal means: as for example,

575—*Abordons l'Ennemi:* that is to ſay, *let us board the Enemy.*

576—*Abandonnez le Vaiſſeau que vous battez:* that is to ſay, *Abandon the ſhip you are engaged with.*

You muſt carefully obſerve to reſerve for the *ſignals of action*, the numbers which are formed with the firſt figures, that they may be indicated with no more than *one* or *two* pendants.

One and the ſame particular colour, is to be given to all the ſhips of each diviſion, by means of which it may, at any time, be known which ſhe belongs to.

None of the national flags, broad-pendants, or colours, which ſerve to mark and diſtinguiſh the diviſions from each other, are ever to be made uſe of for, or underſtood as, a ſignal.

As, when at ſea, one is expoſed to make a great many queſtions, the ſhip, to which thoſe queſtions are made, is to anſwer them inſtantly, by a ſignal of affirmation, or negation, meaning a plain *aye* or *no*, without any preamble, &c. &c.

ARTICLE I.

Of Day-ſignals, when far a-part one from another.

M. la Bourdonnaye, whoſe genius always prompted him to ſtrike out new and uſeful inventions, contrived this ſpecies of signals, for the handineſs of getting himſelf underſtood by a whole fleet, by means of *Pendants* and *Flags*. Accordingly, you are then to make uſe of the four colours, *White*, *Red*, *Blue*, and *Yellow*, becauſe they are all very ſtriking colours; and, to place them by way of ſignals, you are to make uſe of the enſign-ſtaff, the mizen-yard, the mizen top-gallant maſt, the main top-gallant maſt, and the fore top-gallant maſt; obſerving that the firſt figure

figure, that is to ſay, that which is to be put up firſt, in making the ſignals, will be ſignified by the *White* and *Blue* pendants wherever they may be placed; the ſecond will be known by the *Red* and *Yellow* pendants; the third by the *Yellow* and *Red* flags. The *figure* 1, of the firſt column, or that which makes the *hundreds*, in the uſual way of ſetting figures on paper, will be ſpecified by the *White Pendant* at the flag-ſtaff; *fig*. 2, at the mizen-yard; *fig*. 3, at the mizen top-gallant maſt; *fig*. 4, at the main top-gallant maſt; *fig*. 5, at the fore top-gallant maſt; *fig*. 6, by the *Blue Pendant* at the flag-ſtaff; *fig*. 7, at the mizen-yard; *fig*. 8, at the mizen top-gallant maſt; *fig*. 9, at the main top-gallant maſt; *fig*. 0, at the fore top-gallant maſt.

The *figure* 1, of the ſecond column (or that which in the uſual way of writing is reputed the *tenths)*, and which muſt be taken down as the ſecond figure in the ſignal, will be expreſſed by the *Red Pendant* at the enſign-ſtaff; *fig*. 2, at the mizen-yard; *fig*. 3, at the mizen top-gallant maſt; *fig*. 4, at the main top-gallant maſt; *fig*. 5, at the fore top-gallant maſt; *fig*. 6, by the *Yellow Pendant* at the flag-ſtaff; *fig*. 7, at the mizen-yard; *fig*. 8, at the mizen top-gallant maſt; *fig*. 9, at the main top-gallant maſt; *fig*. 0, at the fore top-gallant maſt.

The *figure* 1, of the third column (according to the uſual way of writing, where it is reputed the *unites)*, and which is to be taken down as the third figure in the ſignal, will be expreſſed by the *Yellow Flag* a-ſtern; *fig*. 2, at the mizen-yard; *fig*. 3, at the mizen top-gallant maſt; *fig*. 4, at the main top-gallant maſt; *fig*. 5, at the fore top-gallant maſt; *fig*. 6, by the *Red Flag* a-ſtern; *fig*. 7, at the mizen-yard; *fig*. 8, at the mizen top-gallant maſt; *fig*. 9, at the main top-gallant maſt; *fig*. 0, at the fore top-gallant maſt.

This once ſettled and agreed upon, you may make as many ſignals as you pleaſe: for example, ſhould you want to ſignal N° 105, you have only to hoiſt the *White Pendant* at the flag-ſtaff; the

the *Yellow* at the fore top-gallant maſt, and the *Yellow Flag* beneath the *Pendant* of the fore top-gallant maſt; in which caſe the ſail is to be hauled down, if it be ſet, as well as the diſtinguiſhing flag. Should the ſignal 297 be wanting, the way to ſhow it will be a *White Pendant* at the mizen-yard, a *Yellow* one at the main top-gallant maſt, and a *Red Flag* at the mizen yard, beneath the *White Pendant*. The ſignal 333 will be executed by a *White Pendant* at the mizen top-gallant maſt, a *Red* one at the ſame maſt beneath the *White*, and the *Yellow Flag* beneath theſe two on the ſame maſt. Finally, were you to ſignal 123, *White Pendant* a-ſtern, *Red* at the mizen-yard, and *Yellow Flag* at the main top-gallant maſt, would be the way.

ARTICLE II.

Of Signals in miſty or foggy weather.

In miſty or foggy weather, ſignals cannot be made otherwiſe but by the firing of the great-guns, and muſkets; ſometimes, alſo, it is done by the ringing of the bells, and at other times by the beating of the drums. The difference between the Admiral's, and their reſpective diviſions, is, in thoſe caſes, made ſenſible, either by the number of guns, or the mode of firing, or that of drumming.

ARTICLE III.

Of Night-Signals.

Night-Signals are to be expreſſed by lights, and gun-firings; on the value of which it muſt have been agreed beforehand: for example, each light will tell for *one*, and each gun-firing *ſeven*, more or leſs, according as may be agreed upon; ſo that, if you want to ſignal Nº 27, you fire *two* guns, after having put three lights

 wherever

wherever you pleaſe, provided they are placed in the moſt conſpicuous place; and that ſignal is to be repeated by the repeating-frigate.—*Six* lights, and *four* guns will, therefore, make 34, and ſo on.

When you wiſh not to be heard at a diſtance, you have but to burn out ſome flaſhes in the pan, or fire ſome muſkets, or ſwivels, inſtead of great-guns.

When you want to know how many ſhips you are together, or give your comrades notice of your being there, it may be done by firing ſquibs, or ſky-rockets: but theſe muſt never be uſed as ſignals, on account of their being ſo liable to miſs; and that, being obliged to ſet fire to ſome others, it would only perplex the ſignal; eſpecially when the gale is ſtrong, and the ſea ſwelled.

The mode of making night-ſignals by means of numbers, is the cleareſt and plaineſt of all; for you have only to reckon the number of lights to be informed of them, though ever ſo far at a diſtance. Should you, on the contrary, content yourſelf with placing your light in ſuch or ſuch a particular place of the ſhip, it would often be very difficult to ſee where they are placed, eſpecially if your ſhip was ſeen obliquely, either from head to ſtern, or from ſtern to head. Now, again, ſhould your ſhip have much pitching, or rolling, it might happen thoſe to windward would have knowledge of your light, while thoſe to leeward would ſee nothing. Hence many miſtakes might ariſe, which will never happen, if you make your ſignals as we have explained it.

FINIS.

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